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ABSTRACT

This curriculum guide from British Columbia is divided into five parts. Part 1, on using the guide, first explains the place of the guide in the provincial curriculum development and articulation processes. Four purposes are defined; the scope of the curriculum is outlined; and an overview of curriculum aim, learner goals, and topics is given. In part 2, the curriculum design is presented, beginning with a background survey of the current state and future needs in adult basic education (ABE) Mathematics. Guidelines for specific program and course planning are included, with representative course designs. Part 3, (Learning Tasks and Resources) contains a systematic array of mathematics topics, including descriptions of typical learning tasks keyed to a limited selection of resource texts. Part 4, (approaches to Teaching and Learning) presents a variety of ideas for instructors to consider in planning ABE mathematics instruction, including brief sections on principles and methods of adult learning, math anxiety, problem solving, computers, and issues in evaluation. Part 5 contains a list of selected instructional resources and professional references, along with a list of publishers' addresses. The final pages constitute a response form for users to comment on this draft curriculum. (MNS)

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Adult Basic Education

Mathematics

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ADULT BASIC EDUCATION
MATHEMATICS
CURRICULUM GUIDE

PROVINCE OF BRITISH COLUMBIA
MINISTRY OF EDUCATION
1983

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THE PLAN OF THIS BOOK

This curriculum guide is divided into five distinct parts for ease of use and reference.

Part 1 Using the Curriculum Guide first explains the place of the guide in the provincial curriculum development and articulation processes. Four purposes of the guide are then defined. Next, the scope of the curriculum is outlined, followed by the overview of curriculum aim, learner goals, and topics.

Part 2 Curriculum Design begins with the background survey of the current state and future needs in ABE Mathematics, which guided the overall design of this curriculum. The following section provides instructors and programmers with guidelines for specific program and course planning, and includes representative course designs.

Part 3 Learning Tasks and Resources is the 'working section' of the book. It contains a systematic array of mathematics topics, including description of typical learning tasks keyed into a limited selection of resource texts.

Part 4 Approaches to Teaching and Learning presents a variety of ideas for instructors to consider in planning ABE mathematics instruction. This part includes brief sections on principles and methods of adult learning, math anxiety, problem solving, computers, and issues in evaluation.

Part 5 Selected Resources contains a list of selected instructional resources and professional references, along with a list of publishers' addresses.

The final pages of the book constitute the 'response form', which users are requested to return to the Ministry with their comments on this draft curriculum.

CURRICULUM GUIDES AND PROGRAM ARTICULATION

This document is one of a series of adult basic education curriculum guides issued by the Continuing Education Division of the Ministry of Education. The guides cover the areas of English and Communications, Mathematics, and Science, from the end of basic literacy through secondary school completion or equivalent.

It is intended that a wide variety of courses including ABE 3, ABE 4, college preparation, and secondary school courses for adults will be developed or revised within the framework of the curriculum guides. For this purpose, each guide contains a section on course design, including samples of a range of representative courses. Specific course content or textbooks are not, however, prescribed by these guides.

Over the past two years, several groups have suggested to the Ministry that an articulation of ABE curriculum and certification should be accomplished. Specifically, in the Spring of 1983, the project advisory committees for both the Science and Mathematics curriculum guides recommended that "the Ministry should initiate a process to address provincial articulation concerns of the ABE curriculum in Science, English and Communications, and Mathematics...".

Consequently, during the year 1983/84, the Ministry of Education plans to initiate a consultative articulation process for adult basic education programs. Expected outcomes of this process are as follows:

- rationalization of program and course titles;
- establishment of certification criteria;
- consensus on appropriate balance of subjects within a program.

The articulation process will involve consultation with a broadly based committee drawn from institutions involved in the delivery of adult basic education. The three ABE curriculum guides produced to date will be an important part of the 'working papers' of the committee. It is expected that this activity will, among other benefits, improve transferability of ABE students between institutions.

Meanwhile, this guide is being distributed as a 'Response Draft'. This step in the curriculum development process provides further opportunity for practitioners to examine, discuss, and comment on this major area of adult learning.

Written comments and suggestions should be sent, either on the sheet at the end of this book, or separately, to:

Co-ordinator, Adult Basic Education
Continuing Education Division
Post-Secondary Department
Ministry of Education
Parliament Buildings
Victoria, B.C. V8V 2M4 by March 31, 1984.

It is the hope of the Ministry of Education that instructors, administrators, and representative groups will take this opportunity to provide the 'response from the field' that will improve the effectiveness and use of this document.

Ron Faris
Executive Director
Continuing Education Division

PURPOSES OF THE GUIDE

Beyond the global purpose of encouraging high-quality learning opportunities for adults in ABE mathematics courses, this guide has four specific purposes.

The first is to define the place of mathematics in adult basic education by a statement of aim and goals.

The second purpose is to present an array of learning topics, with sample tasks and resources for instruction. Instructors and course designers can select from this array when planning specific courses or units, making local adaptations as appropriate to student goals, instructor preferences, and local resources.

The third purpose is to provide a flexible structure for course design, which can accomodate:

* various effective approaches to mathematics instruction for adults;
* selection and adaptation of curriculum so that it is appropriate to adult interest and need;
* various delivery modes including on-campus instruction, outreach classes or distance learning;
* direct group instruction or self-paced learning;
* adaptation to a wide range of texts and other resources that may change from time to time;
* other constraints of time, space, and resources.

The fourth purpose of the guide is to provide administrators and instructors with a planning framework that will assist them to:

* co-ordinate courses within an institution;
* articulate course outcomes among institutions across the province;
* assess and certify levels of student achievement;
* define curriculum development needs.

SCOPE OF THE CURRICULUM

This curriculum is intended for adult learners who have gone beyond the minimum competency level best described as 'numeracy'. A minimum facility with the basic operations of the base 10 number system is assumed. The upper limit of the curriculum range may generally be taken as secondary school completion or equivalent.

Current titles of courses within this range include ABE/BTSD levels 2, 3, and 4, College Foundations or College Preparatory Mathematics, Mathematics Improvement, and Mathematics 10, Algebra 11 and Algebra 12, Business and Consumer Mathematics 11, Industrial and Trade Mathematics 11 in the adult secondary school program. Further rationalization of curriculum in these courses will be facilitated by ABE articulation efforts now underway (see page 1).

The primary approach of this guide, however, is to define a curriculum for a wide clientele of adult learners who want to improve their competence in mathematics.

Grade level equivalents and conventional course titles have therefore been put aside for the purpose of this guide. Instead, the topics and learning tasks emerge from a general aim and three broad goals established for the ABE mathematics curriculum, i.e., mathematics for personal use, for career needs, and for transfer to further education.

OVERVIEW OF CURRICULUM AIM, LEARNER GOALS, AND TOPICS

The curriculum aim, learner goals and topics were established by the curriculum development team on the basis of:

- a survey of the current state and future needs in ABE Mathematics (summarized in Part 2 of this guide);
- direction from a field-based, provincial advisory committee;
- consultation with a field review panel of ABE mathematics instructors;
- current trends in mathematics education.

The topics are first categorized according to learner goal, i.e , Personal, Career or Transfer. They are then subdivided into sets of Fundamental and Application topics.

Learning tasks and resources are outlined for each topic and are presented in detail in Part 3 of the guide

The relationship of the aim, goals, topics, tasks, and resources is shown by this diagram.

THE CURRICULUM AIM
is achieved by providing for adults to attain
LEARNER GOALS
that may be broadly categorized as

Personal Goals	**Career Goals**	**Transfer Goals**

The curriculum is divided into
corresponding sets of
TOPICS
that in turn are classed as
Personal **Career** **Transfer**
and divided into two levels
Fundamentals and Applications

Thus there are six sets of topics from
which to build a mathematics course

Personal Math Fundamentals	**Career Math Fundamentals**	**Transfer Math Fundamentals**
Personal Math Applications	**Career Math Applications**	**Transfer Math Applications**

For each set of topics, the curriculum guide identifies

LEARNING TASKS and RESOURCES

CURRICULUM AIM

The aim is to enable adult learners to acquire the mathematical knowledge, skills, and strategies needed to attain personal or career goals and/or transfer to further education.

LEARNER GOALS

Personal: Acquire the competence in mathematics required for personal use in the societal roles of family member, consumer, community member, and citizen.

Career: Acquire the competence in mathematics required for career use in the societal roles related to work.

Transfer: Acquire the competence in mathematics required for transfer to further educational study in the societal role of lifelong learner.

TOPICS

(PF) **Personal Math Fundamentals**

PF1: Whole Numbers
PF2: Decimals
PF3: Fractions
PF4: Metric Measurement
PF5: Percentages
PF6: Tables, Graphs and Charts
PF7: Calculators

(PA) **Personal Math Applications**

PA1: Bank Accounts
PA2: Budget
PA3: Cash Transactions
PA4: Consumer Credit
PA5: Housing
PA6: Travel
PA7: Transportation
PA8: Home Renovation
PA9: Insurance
PA10: Pay Cheques
PA11: Income Tax
PA12: Property Tax
PA13: Utilities

(CF) Career Math Fundamentals

CF1: Whole Numbers
CF2: Decimals
CF3: Fractions
CF4: Metric Measurement
CF5: Formulae
CF6: Ratio and Proportion
CF7: Percentages

(CA) Career Math Applications

CA1: Numerical Data
CA2: Geometry - Lines and Angles
CA3: Geometry - Circles and Polygons
CA4: Plane Figures - Basic Measures
CA5: Solid Figures - Basic Measures
CA6: Pythagorean Theorem
CA7: Right Triangle Trigonometry
CA8: Geometric Construction
CA9: Profit and Loss
CA10: Simple and Compound Interest
CA11: Discount and Commission
CA12: Payroll
CA13: Statistics
CA14: Plane Figures - Linear and Area Measurement
CA15: Solid Figures - Surface Area and Volume
CA16: Trigonometry
CA17: Advanced Constructions
CA18: Advanced Interest and Discount
CA19: Compound Interest and Annuities

(TF) Transfer Math Fundamentals

TF1: Properties of the Number System
TF2: Rational Numbers and Exponents
TF3: Polynomials
TF4: Linear Equations
TF5: Cartesian Graphing
TF6: Systems of Equations
TF7: Quadratic Sentences

(TF) Transfer Math Applications

TA1: Polynomials and Rational Expressions
TA2: Radical Expressions
TA3: Quadratic Sentences
TA4: Systems of Equations
TA5: Trigonometry - Basics
TA6: Imaginary and Complex Numbers
TA7: Conics
TA8: Exponential and Logarithmic Functions
TA9: Polynomial Functions and Graphing Techniques
TA10: Sequences, Series and Binomial Theorem
TA11: Trigonometry - Advanced

ABE MATHEMATICS: CURRENT STATE AND FUTURE NEEDS

Institutions throughout British Columbia offer instruction in mathematics in a variety of forms and at a number of levels. Mathematics represents a major component of most Adult Basic Education programs from Level 1 through Level 4, college preparatory, and adult secondary completion. Courses are offered at central campuses, at isolated satellites, and through distance learning. They are often available both day and night, and for both full-time or part-time learners. Instruction may be by conventional classroom lecture/demonstration methods, by individualized tutoring and learning laboratories, by a self-paced, modular method, or by these and other methods in combination.

While a review of current course offerings in ABE mathematics revealed this diversity, it also discovered a need for definition and clarification of the common ground in the curriculum. A recurrent theme voiced by practitioners was the need for a clearly defined, province-wide curriculum that would provide guidance in discussions and decisions about course content, standards, certification, transfer of student credit, and general program articulation and co-ordination.

In its investigations into the current state and future needs in ABE mathematics, the development team were able to draw on the experience and advice of three groups of practitioners. A broadly based advisory committee included representatives from colleges, school districts, and both the post-secondary and schools departments of the Ministry of Education; the advisory committee provided project guidelines and reviewed major drafts. A field review panel from seven colleges and a large school district program provided specific feedback on curriculum content, especially regarding the arrays of learning tasks and resources. (The membership of these groups is shown in the Acknowledgments section of this guide). Also valuable were the suggestions of 15 participants in an instructor's workshop held in co-operation with the Adult Basic Education Association of British Columbia in March, 1983.

Common to these discussions were several familiar curricular questions.

* What should be the aim of ABE mathematics instruction?

* What use is mathematics to the adult learner?

* What topics should be included in an adult mathematics curriculum?

* What is the most useful way to array these topics in a curriculum guide?

Summarized below are the broad answers to these questions, as the curriculum development team interpreted them in the course of their work.

What should be the aim of ABE mathematics instruction?

A broad statement of aim can help set the overall direction of a curriculum revision effort. While it is a general statement, this aim is built around six key words: the knowledge, skills, and strategies that constitute the discipline of mathematics, and the personal, career, and transfer goals of the learners. Thus, the aim of the curriculum is as follows:

> "to enable adult learners to acquire the mathematical knowledge, skills, and strategies needed to attain personal or career goals and/or transfer to further education".

What use is mathematics to the adult learner?

The value of any new learning (or refreshing the memory of past learning and experience) in an adult education context is capable of almost infinite, and very individual, variation. A group of 30 adult learners could readily attest to well over 30 different uses that mathematics might have for them. Yet a curriculum developer seeks to categorize these actual or potential uses in some way to guide curriculum design. If the design and content directly reflect adult learning needs, then the resulting curriculum will likely display the characteristics of adult interest, relevance, practicality, challenge, and flexibility.

The approach taken in several current provincial curriculum development projects (including the ABE English and Communications Curriculum Guide, the ABE Science Curriculum Guide, and the (ESL) English for Work guide once again proved to be a useful organizer. The approach is outlined in a working paper on curriculum development in ABE (B.C. Ministry of Education, 1983), which analyzes adult learning needs in the context of six societal roles.

These are the roles defined for the purpose of curriculum development and design.

Family Member
Consumer
Community Member
Citizen
Worker
Learner

In each of these life roles, adults continually face a range of developmental tasks, often looking to the education systems for learning opportunities. Their expressed learning needs reflect not only their own interests, but also the changing expectations of society.

The role of learner is particularly critical. It may serve as an adjunct to one of the other roles; moreover, it may also set the context for an individual's fundamental desire for personal growth and intellectual development, independently of other social role expectations.

For the purposes of this curriculum guide, it was found practical to consolidate the learner goals into three categories.

Personal: Acquire the competence in mathematics required for personal use in the societal roles of family member, consumer, community member, and citizen.

Career: Acquire the competence in mathematics required for career use in the societal roles related to work.

Transfer: Acquire the competence in mathematics required for transfer to further educational study in the societal role of lifelong learner.

These three learner goals provided a key dimension in the structuring of the topics and learning tasks subsequently selected for inclusion in this draft of the guide.

What topics should be included in an adult mathematics curriculum?

A number of recent studies in British Columbia, as well as a series of federal Canadian studies and a major United States ABE project, provided a rich base of information on potential mathematics content and ways it might be organized. The B.C. studies were those reported by Starr Owen (1979) and Paul Grinder (1983).

Owen identified the mathematics and science knowledge and skills required by adult students prior to entering trades training at the Vancouver Vocational Institute. Grinder surveyed in detail the mathematics competence considered prerequisite to vocational programs at Cariboo, East Kootenay, Okanagan and Selkirk Colleges. He also determined what skills were actually taught or reviewed in the various vocational programs themselves.

In a series of federal government studies, Arthur Smith (Canada Employment and Immigration Commission, 1978) sought to define those 'generic' skills that were the common requirements of occupations in Canada.

In contrast to the foregoing research that focussed primarily on the roles of the adult as workers or learners, the Adult Performance Level study in the United States (Northcutt, 1975) identified specific computational skills and problem-solving strategies needed by adults seeking to function effectively and independently as consumers, community members, and citizens.

Essential also to the development of this guide were two key documents of the Schools Department of the Ministry of Education, the current Mathematics Years 1-12 Curriculum Guide (1978), and the extensive report on the present state and future directions of the schools curriculum described in the B.C. Mathematics Assessment 1981.

The resulting topics of study, subsequently expanded into specific learning tasks, are summarized on pages 8 to 10 and provided in detail in Part 3 of this guide.

What is the most useful way to array these topics in a curriculum guide?

The major decision made, in response especially to requests from the field for scope and flexibility, was to adopt a 'building-blocks' approach to curriculum design. The topics and component tasks were categorized, first, according to learner goal, and then established as either 'fundamental' or 'application'. This organizing framework and a useful overview of the whole curriculum guide are presented in graphic form on page 6.

It merits repeating that this guide represents an intermediate stage in what should be a continuing cycle of curriculum development and revision. Of all periods of the history of adult education, the current era is the one least amenable to curricula set in stone.

DESIGN OF PROGRAMS AND COURSES

This section outlines an approach to the design of programs and courses that may be a useful point of departure for instructors or departments as they review their mathematics curriculum. First, some terms commonly used (and frequently confused) in curriculum planning are defined. Then a simplified program design model is presented and explained. The section is followed by a number of representative course designs, which together might constitute the core of a department's mathematics program.

Definitions

The following definitions are largely derived from Pratt (1980), and Good (1973). Practitioners seeking further professional background knowledge and specific procedures for curriculum design and development will find David Pratt's basic text a rich source of ideas.

Design: a deliberate process of devising, planning, and selecting the elements, techniques, and procedures that constitute some object or endeavor

Curriculum: an organized set of formal educational intentions

Program: a set of courses designed to meet the stated aim of a curriculum

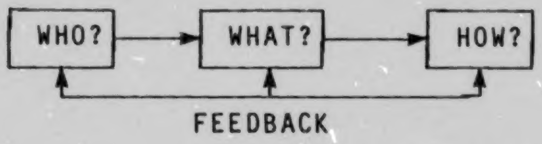
Course: a set of topics that have been determined to meet the goals of learners

Topic: a major subdivision of a course for the purpose of integrated study, synonym for a unit of study, or a theme

Learning Task: a description of what a person should be able to do as a result of learning; synonym for learning objective

A Simplified Program Design Model

The following model of program (or course) design is presented as one approach that a department, or even an individual instructor, might adopt to work through the steps of the planning process. It consists of four steps.



Step 1: WHO?

Establish who is going to receive instruction and who is going to provide instruction.

1.1 Who are the learners? Consider information such as the following:

- * Age range and sex distribution of the learners -- note any predominant groups.
- * Career expectations. What are learners' career goals? Will they change?
- * Motivation factors. Why has each learner enrolled? What type of sponsorship or financial assistance has been made available?

- Further training opportunities. What is available for learners when they have met their immediate goals in mathematics?
- Preferred learning styles of students.
- Previous experience of learners, including any type of learning endeavors.

1.2 Who will provide instruction? Consider information such as the following:

- Background and experience of instructors in mathematics teaching.
- Preferred teaching methods and styles of instructors.
- Background and experience of instructors in adult education.
- Potential for using other human resources, such as markers, aides, or volunteers.

Step 2: WHAT?

2.1 Establish the aim of the mathematics program and the dominant learner goals. Any modifications and departures from those articulated in the curriculum guide should be noted and a consensus established among those providing instruction.

2.2 Determine what selections of topics best meet the goals of learners and what is the best way to organize these topics into courses.

Step 3: HOW?

Establish how the courses are to be offered, considering key variables such as the following:

* Location, time, and cost;
* Class size, or learner-instructor ratio;
* Delivery method;
* Learning resources;
* Professional resources;
* Student placement or course selection procedures;
* Assessment of student progress;
* Course completion or certification criteria;
* Instructor evaluation;
* Course and program evaluation;
* Curriculum revision process.

The process of program and course design is a critical element in the effective delivery of adult basic education. Time and resources invested in that planning process, however, frequently provide a worthwhile rate of return, even in the short term.

Step 4: FEEDBACK

Establish a system to monitor continuously key aspects of the program, such as the following:

* Needs of learners and how they are being met;
* Reliability and validity of the student placement procedure;
* Success of completing students at the next level of study;
* Potential and actual performance of instructors;
* Relevance of curriculum topics;
* Effective use of all instructional resources.

REPRESENTATIVE COURSE DESIGNS

This section presents some representative course designs. They have been developed to illustrate several ways this curriculum guide may be used in course planning. Each course design includes a title and brief descriptions of purpose, context, prerequisites, learning topics, instructional method, evaluation and grading, and resources.

Three examples of courses are provided, one corresponding to each of the three learner goals defined earlier in this curriculum guide (see page 7).

Example 1 is "Mathematics for Personal Use" (Personal Goal);
Example 2 is "Mathematics for Career Use - ABE Level 3"
(Career Goal);
Example 3 is "Mathematics 12 for Adults" (Transfer Goal).

It is expected that the program articulation process will yield additional representative course designs. Meanwhile, the following outlines will provide a model and a framework for further development both within institutions and between providers of ABE programs across the province.

Example 1: MATHEMATICS FOR PERSONAL USE
(Learner Goal: Personal)

Purpose

This course will provide adults with the opportunity to develop knowledge and skills of immediate use to them in their daily lives.

On completion of the course, participants will be able to:

- show that they have mastered the skills of computation most often required of adults in society; and
- apply their mathematical knowledge and skills to practical problems in which they are particularly interested, such as household budgeting, home buying, etc.

Context

Skill in working with numbers is becoming increasingly important in society, especially as more technology is introduced. In particular, an individual's ability to handle major and minor changes in personal and family income or expenditure can have a direct effect on daily life. For most adults, therefore, it is essential to have a basic competence with numbers and how to use them to understand and solve problems.

This is a non-credit, self-improvement course. Adults who are seeking careers in which mathematics has limited application may also find it valuable.

Prerequisites

Some knowledge of the base 10 number system, whole numbers, fractions, and decimals is needed. Students should have a basic reading ability.

Learning Topics

Fundamentals: Sufficient knowledge and skill in the following topics to be able to apply them to practical personal situations.

PF1: Whole Numbers
PF2: Decimals
PF3: Fractions
PF4: Metric Measurement
PF5: Percentages
PF6: Tables, Graphs and Charts
PF7: Calculators

(See pages 35 to 41 for specific learning tasks.)

Applications: Applications of mathematics to selected topics of personal interest and need. Participants will choose topics from the following.

PA1: Bank Accounts
PA2: Budget
PA3: Cash Transactions
PA4: Consumer Credit
PA5: Housing
PA6: Travel
PA7: Transportation
PA8: Home Renovation
PA9: Insurance
PA10: Pay Cheques
PA11: Income Tax
PA12: Property Tax
PA13: Utilities

(See pages 42 to 54 for specific learning tasks.)

Instructional Method

This course will be an individualized one. The study units will feature self-paced mastery learning with tutorial help as required. Self-tests will be available to help learners decide which topics and tasks they need to study or review. Each topic will be mastered to the learner's satisfaction before the next one is begun. Study groups will be set up and co-operation between students encouraged. Provision will be made for people who want to work faster or more slowly.

Evaluation and Grading

Evaluation of learning will be based on a combination of mastery tests (for fundamentals units) and self-assessment (for applications units). No grades will be assigned.

Resources

Instructors have developed individual study units that may be purchased or borrowed. The following texts will also be made available.

Barker, *Arithmetic*.
Bolster, *Mathematics in Life*.
Enns, *ABE Mathematics 2*.
Newton, *Consumer and Career Mathematics*.

Example 2: MATHEMATICS FOR CAREER PREPARATION - ABE LEVEL 3 (Learner Goal: Career)

Purpose

This course is designed to provide adults with the opportunity to develop the knowledge and skills required for entry into contemporary career, trade, vocational, technical, and other training programs.

Context

The availability of relevant education and training is a critical factor in the economic well-being of a community, region, or nation. Likewise, access to training opportunities is essential for adults faced with an accelerating rate of technological and social change. Most people will have to retrain at least once during their working life. This course is designed for those adults who wish to train for a new career but who first need to develop or improve necessary mathematical skills. A grade 10 equivalency certificate is also available on completion of a specific number of course units (see 'Applications' in this example).

Prerequisites

The prerequisites for this course are knowledge and skills in basic arithmetic: sufficient reading ability to study from standard mathematics texts, such as those listed in this example (see 'Resources'). For many adults, the fundamentals of whole numbers, decimals, fractions, and percentages can often be recalled with the aid of a brief review unit.

Learning Topics

Fundamentals: The following topics, each one a separate study unit, review the knowledge and skills required for any career application.

CF1: Whole Numbers
CF2: Decimals
CF3: Fractions
CF4: Metric Measurement
CF5: Formulae
CF6: Ratio and Proportion
CF7: Percentage

Applications: Students will choose applications of mathematics in a number of areas relevant to their career interest. This selection should be guided by the specific requirements for entry to particular training programs. Thus, the number and selection will vary between students. Two sample course outlines are provided in this example (Sample Selection 1 and 2).

It should also be noted that, for this institution, a minimum of 8 units (including at least 5 applications units) are required for a Grade 10 equivalency certificate.

All students select applications topics from this list.

CA1: Numerical Data
CA2: Geometry - Lines and Angles
CA3: Geometry - Circles and Polygons
CA4: Plane Figures - Basic Measures
CA5: Solid figures - Basic Measures
CA6: Pythagorean Theorem
CA7: Right Triangle Trigonometry
CA8: Geometric Construction
CA9: Profit and Loss
CA10: Simple and Compound Interest
CA11: Discount and Commission
CA12: Payroll

Sample Selection 1: Career Goal - Office Administration

Fundamentals: Topics CF1 through CF7

Applications: CA1 Numerical Data
CA9 Profit and Loss
CA10 Simple and Compound Interest
CA11 Discount and Commission
CA12 Payroll

Sample Selection 2: Career Goal - Carpentry

Fundamentals: Topics CF1 through CF7

Applications:
CA1 Numerical Data
CA2 Geometry - Lines and Angles
CA3 Geometry - Circles and Polygons
CA4 Plane Figures - Basic Measures
CA5 Solid Figures - Basic Measures
CA6 Pythagorean Theorem
CA7 Right Angle Triangle
CA8 Geometric Construction

Instructional Method

This course will be an individualized one. The study units will feature self-paced, mastery learning with tutorial help as required. Self-tests will be available to help learners decide which topics and tasks they need to study or review. Each topic will be mastered to the learner's satisfaction before the next one is begun. Study groups will be set up and co-operation between students encouraged. Provision will be made for people who want to work faster or more slowly.

Evaluation and Grading

Evaluation of learning is based on performance on criterion-referenced tests taken at the end of each unit of study. Within each unit, students may also assess their progress with self-scored tests. Final grades are accumulated from unit tests. There is no final examination. A course completion certificate will list specific topics mastered.

Resources

Basic Texts (available on loan or may be purchased)

Boyce, Mathematics for Technical and Vocational Students.
Newton. Consumer and Career Mathematics.
Rogers, Mathematics for Trade and Industrial Occupations.
(Awaiting publication, 1984) ABE Mathematics 3.

Supplementary Texts (available in lab and resource centre)

Boisselle, Using Mathematics in Business.
Carman, Mathematics for the Trades.
Enns, ABE Mathematics 2.
VAST 3 Mathematics.
VAST 4 Mathematics.

Example 3: **MATHEMATICS 12 FOR ADULTS**
(Learner Goal: Transfer)

Purpose

This course is parallel to the Grade 12 survey course in the provincial schools curriculum guide Mathematics 1-12 (1978). It is specified as prerequisite for a number of post-secondary college and institute programs.

Context

Many adults who plan to transfer from the adult basic education program to a university degree, technology diploma, or similar program will require a thorough background and appropriate certification in mathematics at the level outlined below. Emphasis, therefore, will be on a sound understanding of mathematical concepts, theory and preparation for further study, especially in a scientific or technological field.

Prerequisites

Prerequisites include Mathematics 11 or equivalent, or demonstration of appropriate level of knowledge and skill on a placement test.

Learning Topics

The course is divided into two parts, 'Review' and 'Extension'. All topics are selected from the Transfer Applications section of the guide (see pages 91 to 101).

Review

TA1: Polynomials and Rational Expressions
TA2: Radical Expressions
TA3: Quadratic Sentences
TA4: Systems of Equations
TA5: Trigonometry Basics

Extensions

TA6: Imaginary and Complex Numbers
TA7: Conics
TA8: Exponential and Logarithmic Functions
TA9: Polynomial Functions and Graphing Techniques
TA10: Sequences, Series, and Binomial Theorem
TA11: Trigonometry-Advanced

Instructional Methods

The course will be conducted on a lecture and demonstration basis. In addition, small groups will be established to work as study teams. These teams will meet once a week to discuss areas of common interest and to share ideas. Each team will prepare a report on a special project (a particularly interesting application of mathematics to a current topic).

Evaluation and Grading

Study of each topic will be followed by a comprehensive test. Results will provide feedback to the learner on those topics that have been mastered and those that require additional study.

Grading will be based on a final examination and a special project. The final examination will be worth 80%, and the special project will be worth 20% of the final grade. Letter grades will be assigned as follows:

A	86% - 100%
B	76% - 85%
C	66% - 75%
D	60% - 65%
F	Below 60%.

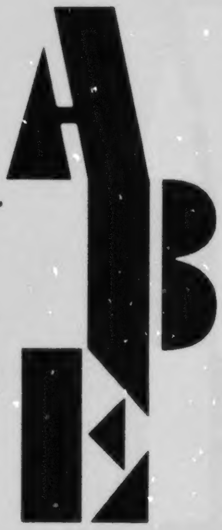
Resources

Basic Text

Keedy, Algebra and Trigonometry.

Supplementary Text

Dolciani, Algebra and Trigonometry: Book 2.



MATHEMATICS FOR PERSONAL USE

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PERSONAL MATH FUNDAMENTALS

Personal Math Fundamentals 1: Whole Numbers

Tasks

PF1.1 Add whole numbers, using a calculator to verify answers.

PF1.2 Subtract whole numbers, using a calculator to verify answers.

PF1.3 Read and write whole numbers to the billions place, and recognize truncated ways of writing large numbers (e.g., 2 billion, 45 million).

PF1.4 Multiply whole numbers with a maximum of 3 digits in the multiplier, using a calculator to varify answers.

PF1.5 Divide whole numbers with a maximum of three digits in the divisor, using a calculator to verify answers.

PF1.6 Round off whole numbers to the nearest ten, hundred, thousand, hundred thousand, and million.

PF1.7 Find an average.

PF1.8 Solve basic problems by writing arithmetic sentences, applying a consistent strategy.

Resources

Barker, Arithmetic: Chapter 1.

Bolster, Mathematics in Life: Chapters 1-3.

Enns, ABE Mathematics 2: Units 1-4.

Novak, Arithmetic: Chapters 1-2.

VAST 3 Mathematics: Unit 1.

Personal Math Fundamentals 2: Decimals

Tasks

PF2.1 Add decimals, with concentration on money and measurement, using a calculator to verify answers.

PF2.2 Subtract decimals, with concentration on money and measurement, using a calculator to verify answers.

PF2.3 Read and write decimal numbers appropriate to personal use.

PF2.4 Round off decimal numbers to the ten-thousandths place, using mainly examples of money and measurement.

PF2.5 Multiply decimals as appropriate to personal situations, using a calculator.

PF2.6 Divide decimals as appropriate to personal situations, using a calculator.

PF2.7 Solve basic problems involving decimals by writing arithmetic sentences, applying a consistent strategy.

Resources

Barker, Arithmetic: Chapter 4.

Bolster, Mathematics in Life: Chapters 4-5.

Enns, ABE Mathematics 2: Units 7-8.

Novak, Arithmetic: Chapter 4.

VAST 3 Mathematics: Unit 3.

Personal Math Fundamentals 3: Fractions

Tasks

PF3.1 Read and write fractions with denominators of 1, 2, 3, 4, 5, 8, 10, 16, 20, 25, 32, 50, and 100.

PF3.1.1 Identify a fractional number

* as a part of a whole number;
* as a part of a set;
* as a comparison of two numbers by division;
* as one with a numerator and a denominator.

PF3.1.2 Identify common, proper, improper, and mixed fractions.

PF3.1.3 Change mixed numbers to improper fractions.

PF3.2 Reduce fractions to their lowest terms.

PF3.3 Find the product of two or more commonly used fractions or mixed numbers.

PF3.4 Find the quotient of two commonly used fractions or mixed numbers.

PF3.5 Write equivalent fractions for numbers having common application (e.g. 1/10 = 10/100; 3/4 = 75/100).

PF3.6 Find the sum of two or more commonly used fractions or mixed numbers.

PF3.7 Find the difference between two commonly used fractions or mixed numbers.

PF3.8 Convert commonly used fractions to decimals, and vice versa.

PF3.9 Solve practical problems by writing arithmetic sentences involving fractions, applying a consistent strategy.

Resources

Barker, Arithmetic: Chapter 3.

Bolster, Mathematics in Life: Chapters 7-8.

Enns, ABE Mathematics 2: Units 5-6.

Novak, Arithmetic: Chapter 3.

VAST 3 Mathematics: Unit 2.

Personal Math Fundamentals 4: Metric Measurement

Tasks

PF4.1	Identify commonly used SI units of linear measurement, mass and capacity, their prefixes and abbreviations.
PF4.2	Change commonly used metric units of one denomination to units of another denomination (e.g., change 1.5 L to 1500 mL).
PF4.3	Measure and calculate the linear dimensions of common geometric figures, such as the rectangle, square, and triangle.
PF4.4	Measure and calculate the linear dimensions of the circle such as the radius, diameter, and circumference.
PF4.5	Measure and calculate common examples of mass (weight).
PF4.6	Measure and calculate common examples of capacity (liquid measure).
PF4.7	Solve practical problems in metric measurement.

Resources

Barker, Arithmetic: Chapter 7.

Bolster, Mathematics in Life: Chapter 6.

Newton, Consumer and Career Mathematics: Chapter 3.

Novak, Arithmetic: Chapter 7.

Personal Math Fundamentals 5: Percentages

Tasks

PF5.1 Read and write commonly used percentages.

PF5.2 Change commonly used percentages into decimals and vice versa, using a calculator.

PF5.3 Find what percentage one number is of another number (e.g., 28 is what percent of 35?), using a calculator.

PF5.4 Find a percentage of a number (e.g., find 18% of 4.85) using a calculator.

PF5.5 Solve practical problems using percent operations including rate and amount of increase (e.g., mark-up, taxes, salary increase, commission, simple interest); rate and amount of decrease (e.g., discount, depreciation, pay-cheque deductions). A consistent strategy will be used to determine a solution, and calculator employed for computation and verification.

Resources

Barker, Arithmetic: Chapter 6.

Bolster, Mathematics in Life: Chapter 11.

Enns, ABE Mathematics 2: Units 9-10.

Novak, Arithmetic: Chapter 6.

VAST 3 Mathematics: Unit 5.

Personal Math Fundamentals 6: Tables, Graphs, and Charts

Tasks

PF6.1 Recognize the value of representing and interpreting mathematical data by tables, graphs, or charts.

PF6.2 List and categorize instances where tables, graphs, and charts may be used effectively to store, display, or retrieve information (e.g., maps, square root tables, income tax tables, height/weight charts).

PF6.3 Read specified data from line graphs, bar graphs, circle graphs, and pictographs.

PF6.4 Draw line graphs and bar graphs representing a set of given data.

PF6.5 Calculate percent of the whole for a given set of appropriate data, and draw a circle graph based on the data.

PF6.6 Use map co-ordinates to locate points on various maps, e.g., city street maps, provincial road maps.

PF6.7 Use the scale of maps to estimate distances between places.

PF6.8 Recognize that information displayed graphically may be intentionally or unintentionally distorted by use of different scales.

PF6.9 Distinguish between (a) graphs that show a causal relationship (e.g., electrical resistance of a wire in relation to its diameter), and (b) graphs that indicate no causal relationship (e.g., change of population over a period of time).

Resources

Bolster, Mathematics in Life: Chapter 12.

Newton, Consumer and Career Mathematics: Chapters 3 and 9.

VAST 3 Mathematics: Unit 9.

Personal Math Fundamentals 7: Calculators

Tasks

PF7.1 Select a calculator with features appropriate to personal needs (e.g., special function keys, metric conversion, printing capability).

PF7.2 Use a calculator to add, subtract, multiply, and divide whole numbers and decimals.

PF7.3 Use a calculator to convert any common fraction to a decimal fraction, recognizing that many decimal fractions must be approximate values.

PF7.4 Use a calculator with percentage:

- PF7.4.1 Find n% of a given number. (e.g., 7% of $19.95)
- PF7.4.2 Compare to quantities by percentage. (e.g., 25 is n% of 95)
- PF7.4.3 Find the total of a purchase using 100% + n% (e.g., sales tax on item is 7%
  cost of item is $19.95
  total cost = 107% x $19.95).

PF7.5 Appreciate that a calculator can save a great deal of time and effort if used appropriately.

Resources

No specific resource references are cited for this topic. Each calculator may vary slightly in operating procedure and capability. Many recent texts include calculator exercises.

NOTE: It is recommended that the calculator be used as a tool for learning throughout the mathematics curriculum. Applications may be introduced at many appropriate points within most units of study.

PERSONAL MATH APPLICATIONS

Personal Math Applications 1: Bank Accounts

Tasks

PA1.1 Explain and compare the main features, advantages and disadvantages of various bank accounts (e.g., chequing, savings, daily interest).

PA1.2 Prepare deposit slips for a variety of bank accounts.

PA1.3 Write cheques or withdrawal forms as appropriate to an account.

PA1.4 Apply fundamental arithmetic required for completion of deposit slips, chequebook balances, bank reconciliations, and interest payments.

Resources

Bolster, Mathematics in Life: Chapter 4.

Newton, Consumer and Career Mathematics: Chapter 5.

VAST 3 Mathematics: Unit 6.

Personal Math Applications 2: Budget

Tasks

PA2.1 Distinguish the general categories of personal or family income (e.g., wages, dividends, family allowance).

PA2.2 Distinguish the general categories of expenditure in a family or personal budget (e.g., housing, utilities, health, clothing, food, transportation, emergencies).

PA2.3 Demonstrate at least one method of preparing a budget.

PA2.4 Solve problems relating to budget preparation, management, and analysis. (See also PA4: Consumer Credit).

PA2.5 Prepare budgets for different levels of income and personal or family needs.

Resources

Newton, Consumer and Career Mathematics: Chapter 18.

VAST 3 Mathematics: Unit 6.

Personal Math Applications 3: Cash Transactions

Tasks

PA3.1 Find the cost of 'n' units of a commodity when the price of one unit is known.

PA3.2 Find the price of one unit of a commodity when the cost of 'n' units is known.

PA3.3 Determine the price per given unit of a commodity when the commodity is sold in different sized packages.

PA3.4 Verify a sales slip that includes more than one item and sales tax at the current rate.

PA3.5 Calculate the total cost of a major article (e.g., appliance or automobile) after sales tax is applied.

PA3.6 Determine the amount of discount and/or the net price when the list price and rate of discount are known.

PA3.7 Determine the rate of discount when the list price and the amount of a discount are known.

PA3.8 Determine the amount of discount and the rate of discount when list price and reduced price are known.

PA3.9 Compare value between two discounts when the list prices and discounts vary.

Resources

Bolster, Mathematics in Life: Chapters 2, 3, 4, 10, and 11.

Personal Math Applications 4: Consumer Credit

Tasks

PA4.1 Describe various types of credit plans (e.g., open accounts, revolving credit, installment credit).

PA4.2 List the various sources of credit (e.g., banks, credit unions, loan companies, credit card companies).

PA4.3 Fill out an application for credit.

PA4.4 Explain the meaning of terms such as consumer credit, credit rating, credit check, credit reference, etc.

PA4.5 Identify types of credit charges and apply mathematical skills to verify charges (e.g., flat sum, percentage, monthly rate, charge on unpaid balance).

PA4.6 Identify and describe factors affecting credit costs, and apply mathematical skills to compute costs (e.g., service charge, rate of interest, loan insurance, amount borrowed).

PA4.7 Explain the opportunities and problems associated with consumer use of credit.

Resources

Boisselle, Using Mathematics in Business: Chapter 10.

Bolster, Mathematics in Life: Chapter 11.

Newton, Consumer and Career Mathematics: Chapter 6.

VAST 3 Mathematics: Unit 6.

Personal Math Applications 5: Housing

Tasks

PA5.1 List and explain factors that should be considered before buying a home (e.g., length of stay in a community, financing, location, nearness to schools).

PA5.2 List and explain costs connected with buying or selling a home (e.g., real estate fees, legal fees, mortgage types and influence of rates, taxes).

PA5.3 List and explain costs associated with owning a home (e.g., repairs, upkeep, utilities, taxes, insurance).

PA5.4 Solve problems related to home ownership (e.g., compute ownership costs, use amortization tables).

PA5.5 List and explain costs associated with renting a home (e.g. utilities, insurance, damage deposits).

PA5.6 Solve problems relating to utilities. (See also PA 13: Utilities)

PA5.7 Compare the relative costs of buying a home and renting accommodation.

Resources

Boisselle, Using Mathematics in Business: Chapter 10.

Newton, Consumer and Career Mathematics: Chapters 10-12.

VAST 3 Mathematics: Unit 6.

Personal Math Applications 6: Travel

Tasks

PA6.1 Use arithmetic skills to determine component and total costs of a real (or hypothetical) trip between any two points.

PA6.2 Solve problems relating to travel by railroad, bus, plane or private automobile (e.g., compare costs and time, compute average speed, use timetables).

PA6.3 Use arithmetic skills to determine best means of travel for various business or pleasure trips, taking into account factors such as time, distance, purpose, and cost.

PA6.4 Convert Canadian dollars into foreign currency by using appropriate exchange rate tables from a newspaper.

Resources

Bolster, Mathematics in Life: Chapters 1 and 10.

Newton, Consumer and Career Mathematics: Chapter 9.

Personal Math Applications 7: Transportation

Tasks

PA7.1	List and explain advantages and disadvantages of buying a new or used vehicle.
PA7.2	List and explain items to consider when buying a new or used vehicle (e.g., size, extras, financing, operating costs).
PA7.3	List and explain factors that affect selling price of a new or used vehicle (e.g., mark up, depreciation, sales commission, mileage, previous ownership).
PA7.4	List and calculate costs of purchasing a new or used vehicle (e.g., insurance, interest charges, operating costs, repairs).
PA7.5	Compare relative dollar value of purchasing a new and used vehicle.

Resources

Newton, Consumer and Career Mathematics: Chapters 7 and 8.

VAST 3 Mathematics: Unit 6.

Personal Math Applications 8: Home Renovation

Tasks

PA8.1 Measure accurately, using tape or carpenter rule, to determine needed information in appropriate units, (e.g., linear measure for a fence; square measure for carpet, paint or wallpaper; cubic measure for heating).

PA8.2 Draw to scale appropriate diagram of proposed renovations (e.g., floor plan for purchase of carpet).

PA8.3 Estimate costs of renovations based on materials, time, and labor.

PA8.4 Determine the most economical way to finance a renovation plan, applying principles of cash and credit purchases.

PA8.5 Make a detailed plan for real (or hypothetical) renovations, including list of materials, estimates of all costs, and a complete time plan.

Resources

Newton, Consumer and Career Mathematics: Chapter 7.

Personal Math Applications 9: Insurance

Tasks

PA9.1 Explain, with examples, the concept of insurance as a method of providing protection against losses incurred as a result of death, accident, damage, unemployment, etc.

PA9.2 List and explain factors involved in planning insurance coverage (e.g., selection of risks to cover, determining amount of insurance needed, affordability of premiums).

PA9.3 Understand and explain information contained in common insurance policies (e.g., coverage, exclusions, deductible benefits, premium amount, term of policy).

PA9.4 Explain different types of insurance (e.g., term life, whole life, property insurance, auto insurance, disability insurance, unemployment insurance).

PA9.5 Solve problems involving the purchase of insurance in real (or hypothetical) situations.

Resources

Newton, Consumer and Career Mathematics: Chapter 5.

Personal Math Applications 10: Pay Cheques

Tasks

PA10.1 Explain, with examples, the differences between gross pay and take-home pay.

PA10.2 Identify on a typical payroll stub the various deductions from gross pay (e.g., income tax, CPP, UIC, union dues, medical plans, pension), and explain how they are calculated or determined.

PA10.3 Compute take-home pay when given hourly wage rate, hours worked, and deductions.

PA10.4 Identify possible voluntary deductions, and establish personal criteria for decisions about them.

PA10.5 Compute wages and income for different types of payment methods, including straight-time pay, overtime pay, commissions, and piece rates.

PA10.6 Determine the kind and amount of benefits or coverage received from pay-cheque deductions.

PA10.7 Detail procedures for claiming benefits.

Resources

Bolster, *Mathematics in Life*: Chapter 3.

Personal Math Applications 11: Income Tax

Tasks

PA11.1 Explain the reasons for income tax, how income tax dollars are used by various levels of government, and the relationship of federal and provincial tax rates.

PA11.2 Identify various types of taxes other than personal income tax (e.g., excise tax, sales tax, gas tax).

PA11.3 Explain the principle of graduated income tax rates and the way the rates work in practice.

PA11.4 Distinguish between gross income, net income, and taxable income.

PA11.5 Complete a TD1 taxation form accurately, and explain the reason for this form.

PA11.6 Explain the principle and practice of common income tax deductions (e.g., personal exemption, married exemption, child deduction, union dues, pension).

PA11.7 Complete a real (or hypothetical) personal income tax return.

PA11.8 Determine federal and provincial tax payable, and amount of due payment or refund.

Resources

Newton, Consumer and Career Mathematics: Chapters 4 and 13.

Set of forms obtainable from Revenue Canada office.

Personal Math Applications 12: Property Tax

Tasks

PA12.1 Identify and explain with examples the key terms used on property tax forms (e.g. assessed value, real value, school tax assessment, mill rate).

PA12.2 Verify a property tax bill when the real and assessed values and mill rates are provided.

PA12.3 Detail procedures for appealing a property tax bill.

Resources

Newton, Consumer and Career Mathematics: Chapter 11.

Personal Math Applications 13: Utilities

Tasks

PA13.1 Determine the cost of operating a variety of electric appliances, given the rate of electricity consumption of each appliance and the rate per kilowatt hour.

PA13.2 Verify total billing for electricity, given meter readings and rate per kilowatt hour (including taxes).

PA13.3 Verify total billing for oil or gas when consumption and rates are provided (including taxes).

PA13.4 Verify telephone billing given rental costs and long-distance billings (including taxes).

PA13.5 Solve problems relating to utility costs (e.g., compare costs of heating by alternative methods).

Resource

Bolster, *Mathematics in Life*: Chapter 5.

MATHEMATICS FOR CAREERS

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CAREER MATH FUNDAMENTALS

Career Math Fundamentals 1: Whole Numbers

Tasks

CF1.1 Add whole numbers.

CF1.2 Subtract whole numbers.

CF1.3 Read and write whole numbers.

CF1.4 Multiply whole numbers.

CF1.5 Divide whole numbers.

CF1.6 Round off whole numbers.

CF1.7 Find an average.

CF1.8 Solve practical problems using the arithmetic of whole numbers.

Resources

Barker, Arithmetic: Chapter 1.

Bolster, Mathematics in Life: Chapters 1-3.

Enns, ABE Mathematics 2: Units 1-4.

Novak, Arithmetic: Chapters 1-2.

VAST 3 Mathematics: Unit 1.

Career Math Fundamentals 2: Decimals

Tasks

CF2.1 Add decimals.

CF2.2 Subtract decimals.

CF2.3 Read and write decimal numbers.

CF2.4 Round off decimal numbers.

CF2.5 Multiply decimals.

CF2.6 Divide decimals.

CF2.7 Solve practical problems using the arithmetic of decimal numbers.

Resources

Barker, *Arithmetic*: Chapter 4.

Bolster, *Mathematics in Life*: Chapters 4 and 5.

Enns, *ABE Mathematics 2*: Units 7-8.

Novak, *Arithmetic*: Chapters 4.

VAST 3 Mathematics: Unit 3.

Career Math Fundamentals 3: Fractions

Tasks

CF3.1 Read and write fractions, including:

CF3.1.1 Identify a fractional number

- as a part of a whole,
- as a part of a set,
- as a comparison of two numbers by division,
- as one with a numerator and a denominator.

CF3.1.2 Identify common, proper, improper, and mixed fractions.

CF3.1.3 Change mixed numbers to improper fractions.

CF3.2 Reduce fractions to their lowest terms.

CF3.3 Find the product of two or more fractions or mixed numbers.

CF3.4 Find the quotient of two fractions or mixed numbers.

CF3.5 Write equivalent fractions.

CF3.6 Find the sum of two or more fractions or mixed numbers.

CF3.7 Find the difference between two fractions or mixed numbers.

CF3.8 Convert a fraction to a decimal, and vice versa.

CF3.9 Solve practical problems using the arithmetic of fractional numbers.

Resources

Barker, Arithmetic: Chapter 3.

Bolster, Mathematics in Life: Chapters 7 and 8.

Enns, ABE Mathematics 2: Units 5-6.

Novak, Arithmetic: Chapters 3.

VAST 3 Mathematics: Unit 2.

Career Math Fundamentals 4: Metric Measurement

Tasks

CF4.1 Identify the base SI units of linear measurement, mass, and capacity, their prefixes and abbreviations.

CF4.2 Change metric units of one denomination to units of another denomination (e.g., change 3 762 metres to kilometres).

CF4.3 Measure and calculate the linear dimensions of common geometric figures, such as the rectangle, square, and triangle (e.g., find the perimeter of a square with side 17.5 cm).

CF4.4 Measure and calculate the linear dimensions of the circle, such as the radius, diameter, and circumference.

CF4.5 Measure and calculate mass (weight).

CF4.6 Measure and calculate capacity (liquid measure).

CF4.7 Solve practical problems in metric measurement.

Resources

Barker, Arithmetic: Chapter 7.

Bolster, Mathematics in Life: Chapter 6.

Newton, Consumer and Career Mathematics: Chapter 3.

Novak, Arithmetic: Chapter 7.

Career Math Fundamentals 5: Formulae

Tasks

CF5.1 Define the signs, symbols, and terms used for 'ordering' (e.g., $<$, $>$, $=$, etc.), 'grouping' (e.g., [( )] , etc.), and the mathematical operations (e.g., $+$, $-$, x, etc.) used in manipulating formulae.

CF5.2 Define an unknown number by suitable letter or symbol (e.g., let the length of the distance around this circle be represented by C).

CF5.3 Translate a word problem into equivalent mathematical form, or reverse this process.

CF5.4 Solve examples by using the rules for the order of operations.

CF5.5 Evaluate a formula by substituting designated values for the variables (e.g., find the value of d h when d is 84 and h is 144).

CF5.6 Define an equation as a statement of equality between two mathematical expressions separated by an 'equals' sign.

CF5.7 Solve first degree equations in one variable by using one or more of the following techniques:

* collecting like terms,
* removing grouping symbols,
* applying the appropriate 'reverse operations' axiom(s).

CF5.8 Manipulate formulae to isolate the required variable.

Resources

Carman, Mathematics for the Trades: Chapter 6.

Rogers, Mathematics for Trade and Industrial Occupations: Chapter 10.

VAST 4 Mathematics: Unit 6.

Career Math Fundamentals 6: Ratio and Proportion

Tasks

CF6.1 Define and represent ratio as the simplest form of the relationship between two numbers or quantities.

CF6.2 Solve examples using direct and inverse ratio, including gear ratio, roof pitch, probability, etc.

CF6.3 Define and represent proportion as a statement of equivalence between two ratios.

CF6.4 Solve practical problems, using direct, joint, and combined proportion to find the unknown term in scale drawings, unit cost, motion, recipes, mixtures, etc.

Resources

Barker, Arithmetic: Chapter 5.

Novak, Arithmetic: Chapter 5.

Rogers, Mathematics for Trade and Industrial Occupations: Chapter 11.

VAST 3 Mathematics: Unit 4.

Career Math Fundamentals 7: Percentages

Tasks

CF7.1 Read and write percentages.

CF7.2 Change a percent into a decimal or a fraction, and vice versa.

CF7.3 Find what percent one number is of another number (e.g., 28 is what percent of 35?).

CF7.4 Find a percentage of a number (e.g., find 18% of 4.85).

CF7.5 Find an unknown number when a percentage of it is known (e.g., 85% of what number is 695?).

CF7.6 Solve practical problems using percent operations including:

* rate and amount of increase (e.g., mark-up, taxes, salary increase, commission, simple interest, etc.)

* rate and amount of decrease (e.g., discount, depreciation, pay-cheque deduction, etc.)

* unknown base amount, when both the rate and the amount of increase or decrease are known (e.g., How much would have to be invested at 7% per year in order to receive $580 interest annually?).

Resources

Barker, *Arithmetic*: Chapter 6.

Bolster, *Mathematics in Life*: Chapter 11.

Enns, *ABE Mathematics 2*: Units 9-10.

Novak, *Arithmetic*: Chapter 6.

VAST 3 Mathematics: Unit 5.

Career Math Applications 1: Numerical Data

Tasks

CA1.1 Determine the common measures of central tendency of data (mean, median, mode) and range.

CA1.2 Read, interpret, and construct graphs representing numerical data (e.g., pictograph, horizontal bar, vertical bar, divided bar, multiple bar, line graph, circle graph).

CA1.3 Solve practical problems using measures of central tendency and graphs.

Resources

Bolster, Mathematics in Life: Chapter 12.

Newton, Consumer and Career Mathematics: Chapter 3.

VAST 3 Mathematics: Unit 9.

NOTE: For more advanced work, see CA13: Statistics.

Career Math Applications 2: Geometry - Lines and Angles

Tasks

CA2.1 Identify, define, and use standard geometric terms and notation as applied to lines and angles (e.g., point, segment, line AB, vertex).

CA2.2 Identify, define, label, measure, and draw different kinds of lines (e.g., straight, vertical, horizontal, parallel, perpendicular, transversal, oblique).

CA2.3 Identify, define, label, measure, and draw different kinds of angles (e.g., acute, obtuse, straight, reflex, right, corresponding, vertically opposite, internally opposite, complementary, supplementary).

Resources

Bolster, Mathematics in Life: Chapter 16.

Carman, Mathematics for the Trades: Chapter 7.

Novak, Arithmetic: Chapter 8.

Rogers, Mathematics for Trade and Industrial Occupations: Chapter 12.

VAST 3 Mathematics: Unit 10.

Career Math Applications 3: Geometry - Circles and Polygons

Tasks

CA3.1 Identify, define, and use standard geometric terms and notation as applied to figures (e.g., circumference, triangle, hexagon).

CA3.2 Identify, define, label, measure, and draw different kinds of triangles, and deductively determine the measure of their sides and angles (e.g., scalene, right, acute, obtuse, isosceles, equilateral, congruent, similar).

CA3.3 Identify, define, label, measure, and draw different kinds of polygons, and deductively determine the measure of their sides and angles (e.g., square, rectangle, rhombus, trapezoid, parallelogram, pentagon, hexagon, polygon).

CA3.4 Identify, define, label, measure, and draw the circle and its parts (e.g., centre, radius, diameter, circumference, arc, chord, central angle, segment, sector).

Resources

Bolster, Mathematics in Life: Chapter 17.

Carman, Mathematics for Trades: Chapter 7.

Novak, Arithmetic: Chapter 8.

Rogers, Mathematics for Trade and Industrial Occupations: Chapter 12.

VAST 3 Mathematics: Unit 10.

Career Math Applications 4: Plane Figures - Basic Measures

Tasks

CA4.1 Identify and define area as the measurement of the surface of a figure in appropriate units.

CA4.2 Calculate the areas of circles and polygons and the linear measure of their constituent parts (e.g., calculate the area, the base, or the height of a triangle given two of the measures).

CA4.3 Solve practical problems involving area and inherent linear measurements of triangles, squares, rectangles, parallelograms, trapezoids, circles.

Resources

Barker, Arithmetic: Chapter 7.

Carman, Mathematics for the Trades: Chapter 7.

Novak, Arithmetic: Chapter 8.

VAST 3 Mathematics: Units 8 and 10.

NOTE: For more advanced work, see CA14: Plane Figures - Linear and Area Measurement.

Career Math Applications 5: Solid Figures - Basic Measures

Tasks

CA5.1 Identify, define, label, and draw different kinds of solid geometric figures (e.g., cubes, rectangular solids, cylinders, spheres).

CA5.2 Identify, define, and calculate the surface area of geometric solids in appropriate units.

CA5.3 Identify and define volume as the measurement of the space enclosed by the geometric form given in appropriate units.

CA5.4 Calculate the volume of geometric solids and the linear and area measure of their constituent parts (e.g., calculate the area of the circular base, the height, or the volume of a cylinder given two of the measures).

CA5.5 Identify and define the relationship between volume and capacity, and convert units of cubic measurement to and from units of capacity (e.g., 1 500 cm^3 = 1 500 mL = 1.5 L).

CA5.6 Solve practical problems involving surface area and volume of geometric solids and their constituent parts.

Resources:

Barker, Arithmetic: Chapter 7.

Bolster, Mathematics in Life: Chapter 17.

Novak, Arithmetic: Chapter 8.

Rogers, Mathematics for Trade and Industrial Occupations: Chapter 9.

VAST 3 Mathematics: Units 8 and 10.

NOTE: For more advanced work, see CA15: Solid Figures - Surface Area and Volume.

Career Math Applications 6: Pythagorean Theorem

Tasks

CA6.1 Identify and define the concepts and symbols related to powers of numbers and square roots, and find such powers and square roots (e.g., by calculator, table, or trial and error, find square root of 900).

CA6.2 Identify and define the Pythagorean Theorem, and use it to calculate the length of a side of a right triangle.

CA6.3 Solve practical problems using the Pythagorean Theorem (e.g., areas, sides, diagonals, indirect measurement).

Resources

Barker, Arithmetic: Chapter 9.

Bolster, Mathematics in Life: Chapter 18.

Carman, Mathematics for the Trades: Chapter 7.

Career Math Applications 7: Right Triangle Trigonometry

Tasks

CA7.1 Identify and define the concepts and relationships of the trigonometric ratios for angles in a right triangle for sine, cosine, and tangent

(e.g., tangent = $\frac{\text{length of side opposite the angle}}{\text{length of side adjacent to the angle}}$).

CA7.2 State the fraction form and decimal form of the trigonometric ratios for angles in a right triangle

(e.g., in triangle ABC where AB, the hypotenuse, is 25 and BC, the side opposite, is 7, then sine angle A = 7/25 or 0.28).

CA7.3 Solve for the unknown sides or angles of a right triangle, when given at least one side and any two other parts, by using tables or a calculator (e.g., angle A is 54° 24' and the side adjacent as 8 m, find the hypotenuse).

CA7.4 Solve practical problems for unknown sides or angles in a right-angled triangle, by using tables or a calculator (e.g., angles of elevation and depression, tapers, slope, pitch).

Resources

Bolster, Mathematics in Life: Chapter 18.

Boyce, Mathematics for Technical and Vocational Students: Chapter 15.

Carman, Mathematics for the Trades: Chapter 9.

Rogers, Mathematics for Trade and Industrial Occupations: Chapter 14.

VAST 4 Mathematics: Unit 8.

NOTE: For more advanced work, see CA16: Trigonometry.

Career Math Applications 8: Geometric Construction

Tasks

CA8.1 Identify and define a 'geometric construction' as one made using only a compass and a straight edge.

CA8.2 Make basic geometric constructions including:

- constructing a line segment equal to a given line,
- bisecting a line segment,
- constructing an angle equal to a given angle,
- bisecting an angle,
- constructing a line perpendicular to a given line from a point on the line.

CA8.3 Use the basic geometric constructions to:

- construct a perpendicular to a line through a point outside the line,
- construct a line parallel to a given line,
- divide a line segment into equal parts,
- construct a rectangular figure,
- find the centre of a circle,
- construct a circle containing any three non-collinear points.

CA8.4 Identify, define, and use the basic geometric constructions to construct the mediums and altitudes of a triangle.

CA8.5 Use the basic geometric constructions and given measurements to construct:

- a triangle, given three sides,
- a triangle given two sides and the included angle,
- a triangle given two angles and the included side,
- a rectangular figure given the sides.

CA8.6 Solve practical problems, using the basic geometric constructions and given measurements.

Resources

Boyce, Mathematics for Technical and Vocational Students: Ch. 13.

Rogers, Mathematics for Trade and Industrial Occupations: Ch. 12.

VAST 4 Mathematics: Unit 9.

NOTE: For more advanced work, see CA17: Advanced Constructions.

Career Math Applications 9: Profit and Loss

Tasks

CA9.1 Identify and define the concepts and terminology used in profit and loss (e.g., gross sales, net sales, invoice price, cost price, cost, inventory, handling costs, operating expenses, expense, overhead, profit, gross profit, margin, mark up, net profit, selling price, retail price, sale price, mark down, loss).

CA9.2 Identify and define the concept of rate, in profit or loss applications.

CA9.3 Determine profit and loss, including rate, from given tables of data.

CA9.4 Solve practical problems involving profit and loss, including rate.

Resources

Boisselle, Using Mathematics in Business: Chapter 6.

Career Math Applications 10: Simple and Compound Interest

Tasks

CA10.1 Identify and define the concepts and terminology used in simple and compound interest (e.g., balance, principal, amount, period, present value, time, rate, interest, annual, semi-annual, quarterly).

CA10.2 Determine calendar time including:

- exact time between two dates,
- due date or date of maturity,
- days of grace.

CA10.3 Calculate the unknown when two of principal, amount, or interest are given (i.e., $p + i = A$).

CA10.4 Use the simple interest formula, $i = prt$, to find any unknown when three of interest, principal, rate, or time are given (e.g., How much interest is due after nine months on a loan of $1,400 at 11%?).

CA10.5 Calculate compound interest by:

- successively accumulating simple interest (i.e., period 'n' principal plus period 'n' interest = period 'n + 1' Amount),
- compound interest tables.

CA10.6 Solve practical problems involving simple and compound interest, including loans, mortgages, savings accounts, savings plans, bank discount, etc.

Resources

Boisselle, Using Mathematics in Business: Chapter 9.

Carman, Mathematics for the Trades: Chapter 4.

NOTE: For more advanced work, see CA18: Advanced Interest and Discount, and CA19: Compound Interest and Annuities.

Career Math Applications 11: Discount and Commission

Tasks

CA11.1 Identify and define the concepts and terminology used in discount and commission (e.g., list price, mark down, sales discount, trade discount, chain or series discounts, single equivalent discount, cash discount, net, straight commission, quota, consignment).

CA11.2 Identify and define the concept of rate in discount and commission applications.

CA11.3 Solve examples of discount and commission, including single discount, series discount, cash discount, straight commission, sales over quota, consignment sales, etc.

CA11.4 Solve practical problems involving discount and commission.

Resources

Boisselle, Using Mathematics in Business: Chapters 5 and 7.

Carman, Mathematics for the Trades: Chapter 4.

NOTE: For more advanced work, see CA18: Advanced Interest and Discount.

Career Math Applications 12: Payroll

Tasks

CA12.1 Identify and define the concepts and terminology used in the three basic parts of payroll calculations: gross earnings, deductions, net pay (e.g., salary, wage, piecework, overtime, time card, bonus; Canada Pension, Unemployment Insurance, health insurance, income tax, dependents, exemptions, union dues, vacation pay).

CA12.2 Calculate the three basic parts of a payroll and the payroll summary, given the appropriate information and tables for deductions.

CA12.3 Solve practical problems involving payroll calculations, including straight salary, hourly wages, overtime, straight piece rate, bonus piece rate, and compulsory and employee authorized deductions.

Resources

Boisselle, Using Mathematics in Business: Chapter 11.

VAST 3 Mathematics: Unit 6.

Career Math Applications 13: Statistics

Tasks

CA13.1 Demonstrate mastery of skills and concepts as outlined in CA1: Numerical Data.

CA13.2 Extend the ability to determine the common measures of central tendency, from finding from a set of numerical data to finding from a frequency table.

CA13.3 Determine which of the measures of central tendency describes most appropriately a given set of numerical data (recognizing validity, meaning, bias, distortion, etc.).

CA13.4 Calculate cumulative averages and moving averages from a set of numerical data and graph the results.

CA13.5 Construct a table of frequency and class interval from raw data.

CA13.6 Find, calculate, or construct from a table listing the frequency of occurrence of data items and class interval:

* the weighted average (mean),
* the median,
* histograms or frequency polygons including 'normal curves',
* quartiles, deciles, or percentiles.

CA13.7 Calculate range and standard deviation.

CA13.8 Solve practical problems involving statistics.

Resources

Boisselle, Using Mathematics in Business: Chapter 12.

Newton, Consumer and Career Mathematics: Chapter 3.

VAST 3 Mathematics: Unit 9.

NOTE: For more basic work, see CA1: Numerical Data.

Career Math Applications 14: Plane Figures - Linear and Area Measurement

Tasks

CA14.1 Demonstrate mastery of skills and concepts, as outlined in CA4: Plane Figures - Basic Measures.

CA14.2 Extend the ability to identify, define, label, draw, and calculate the areas of circles and polygons and the linear measure of their constituent parts (e.g., rhombus, annular rings, sector, segment, ellipse, etc., and combined figures.)

CA14.3 Solve practical problems involving area and inherent linear measurements of plane geometric figures.

Resources

Barker, Arithmetic: Chapter 7.

Carman, Mathematics for the Trades: Chapter 7.

Novak, Arithmetic: Chapter 8.

VAST 3 Mathematics: Units 8 and 10.

NOTE: For more basic work, see CA4: Plane Figures - Basic Measurement.

Career Math Applications 15: Solid Figures - Surface Area and Volume

Tasks

CA15.1 Demonstrate mastery of skills and concepts, as outlined in CA5: Solid Figures - Basic Measures.

CA15.2 Extend the ability to identify, define, label, and draw solid geometric figures (e.g., prism, cone, pyramid, hollow cylinder, frustum, solid ring).

CA15.3 Extend the ability to identify, define, and calculate the surface or lateral area of geometric solids.

CA15.4 Extend the ability to identify, define, and calculate the volume of geometric solids and the linear and area measure of their constituent parts (e.g., given the segment of a sphere with a height of 1 cm and a radius of 3 cm, find the radius of the sphere and the volume of the segment).

CA15.5 Solve practical problems involving surface area and volume of geometric solids and their constituent parts.

Resources

Barker, Arithmetic: Chapter 7.

Novak, Arithmetic: Chapter 8.

Rogers, Mathematics for Trade and Industrial Occupations: Chapter 9.

VAST 3 Mathematics: Units 8 and 10.

NOTE: For more basic work, see CA5: Solid Figures - Basic Measurement.

Career Math Applications 16: Trigonometry

Tasks

See Transfer Applications 5 (TA.5).

Career Math Applications 17: Advanced Constructions

Tasks

CA17.1 Demonstrate mastery of skills and concepts, as outlined in CA8: Geometric Constructions.

CA17.2 Extend the ability to make basic geometric constructions such as:

- the circumcircle of a triangle,
- the incircle of a triangle,
- a tangent from a point outside the circle,
- the direct common tangent to two circles,
- the transverse common tangent to two circles
- ellipse,
- angles of 90°, 45°, 22 1/2°, 11 1/2° etc. and combination thereof,
- regular polygons.

CA17.3 Solve practical problems involving geometric constructions.

Resources

Boyce, Mathematics for Technical and Vocational Students: Chapter 13.

Rogers, Mathematics for Trade and Industrial Occupations: Chapter 12.

VAST 4 Mathematics: Unit 9.

NOTE: For more basic work, see CA8: Geometric Constructions.

Career Math Applications 18: Advanced Interest and Discount

Tasks

CA18.1 Demonstrate mastery of skills and concepts, as outlined in CA10: Simple and Compound Interest.

CA18.2 Identify and define additional concepts and terminology used in simple interest and discount (e.g., bank discount, discount interest, nominal interest, effective interest, true interest, proceeds, present value, promissory note, demand loan, instalment loan, revolving credit, carrying charges).

CA18.3 Calculate a schedule of payments of principal and interest, carrying charges, and true interest rate on loans, including demand loans, term loans, instalment loans, credit purchases.

CA18.4 Calculate bank and simple discount, proceeds, and true interest rate on interest and non-interest bearing promissory notes.

CA18.5 Calculate present value of a debt.

CA18.6 Solve practical problems involving simple interest and simple discount.

Resources

Boisselle, Using Mathematics in Business: Chapter 9.

Carman, Mathematics for the Trades: Chapter 4.

NOTE: For more basic work, see CA10: Simple and Compound Interest.

Career Math Applications 19: Compound Interest and Annuities

Tasks

CA19.1 Demonstrate mastery of skills and concepts as outlined in CA10: Simple and Compound Interest.

CA19.2 Identify and define additional concepts and terminology used in compound interest and annuities (e.g. nominal rate, effective rate, present value, equation of value, payment interval, amortization schedule, sinking fund, contingent annuity).

CA19.3 Calculate, using tables or logarithms, compound interest and annuities, including accumulated amount, approximation of time, approximation of rate, beginning principal, present value, etc.

CA19.4 Calculate and prepare amortization schedules and sinking fund schedules.

CA19.5 Solve practical problems involving compound interest and annuities.

Resources

Boisselle, Using Mathematics in Business: Chapter 9.

Carman, Mathematics for the Trades: Chapter 4.

NOTE: For more basic work, see CA10: Simple and Compound Interest.

MATHEMATICS FOR TRANSFER

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TRANSFER MATH FUNDAMENTALS

Transfer Math Fundamentals 1: Properties of the Number System

This topic deals with properties of the base 10 number system as applied to the sets of whole numbers, fractions, and integers.

Tasks

TF1.1 Identify and define:

- the set of natural numbers,
- the set of whole numbers,
- the set of fractions.

TF1.2 Define multiplication, subtraction, division, and exponentiation for whole numbers as:

$$\underbrace{m \bullet n = n + n + n + \ldots\ldots n}_{m\ \text{terms}}$$

$a - b = c$ if and only if $c + b = a$

$a \bullet b = c$ if and only if $c \bullet b = a$

The multiplicative inverse (reciprocal) of $a = \frac{1}{a}$

when $a \neq 0$

$a = \underbrace{a \bullet a \bullet a}_{n\ \text{factors}}$ (where n is a natural number)

TF1.3 Identify and use the commutative, associative, and distributive properties as:

$m + n = n + m$
$m \bullet n = n \bullet m$
$(m + n) + r = m + (n + r)$
$(m \bullet n)\ r = m\ (n \bullet r)$
$m\ (n + r) = m \bullet n + m \bullet r$

TF1.4 Add, subtract, multiply, and divide whole numbers and fractions.

TF1.5 Identify the set of integers and graph members of the set on a number line.

TF1.6 Define absolute value.

TF1.7 Add, multiply, and divide with integers.

TF1.8 Apply the 'order of operations' to computation of whole numbers and integers.

Resources

Barker, *Basic Algebra*: Chapter 1.

Keddy, *Introductory Algebra*: Chapter 1.

Novak, *Introductory Algebra*: Chapter 1.

Transfer Math Fundamentals 2: Rational Numbers and Exponents

This topic deals with properties of the base 10 number system as applied to rational numbers and exponents.

Tasks

TF2.1 Identify and define the set of rational numbers and graph numbers on a number line.

TF2.2 Perform the operations of addition, subtraction, multiplication, and division on the set of rational numbers.

TF2.3 Apply the 'order of operation' to computation with rational numbers.

TF2.4 Identify the terms: base, power, exponent, and root.

TF2.5 Write examples of multiplication using exponents.

TF2.6 Use the rules of exponents to simplify expressions involving exponents.

TF2.7 Identify the commutative, associative, and distributive principles as applied to exponents.

TF2.8 Use a calculator to find square and cube roots.

TF2.9 Use a calculator with examples involving scientific notation.

Resources

Barker, Basic Algebra: Chapter 2.

Keedy, Introductory Algebra: Chapter 2.

Novak, Introductory Algebra: Chapter 2.

Transfer Math Fundamentals 3: Polynomials

This topic deals with basic operations of addition, subtraction, multiplication, and division with literal expressions.

Tasks

TF3.1	Identify the following terms: monomial, binomial, trinomial, polynomial, degree, like terms.
TF3.2	Given any polynomial, combine like terms by adding and subtracting to obtain a polynomial in simplest form.
TF3.3	Find the sum or difference of polynomials.
TF3.4	Evaluate polynomials for given replacements of the variables.
TF3.5	Multiply and divide polynomials.
TF3.6	Carry out factoring operations such as: * find the greatest common monomial factor, * factor trinomials, * factor the difference of squares, * factor by grouping.

Resources

Barker, Basic Algebra: Chapters 3 and 4.

Keedy, Introductory Algebra: Chapters 4, 5, and 7.

Novak, Introductory Algebra: Chapters 2 and 5.

Transfer Math Fundamentals 4: Linear Equations

This topic deals with linear equations in one variable and the application of properties of the number system to solving equations and inequalities.

Tasks

TF4.1 Using the method of applying the inverse operation, solve an equation that involves one operation.

TF4.2 Solve an equation that involves more than one operation, and the collection of like terms.

TF4.3 Translate verbal sentences into algebraic expressions and equations.

TF4.4 Establish problem-solving strategies and apply them to formula problems, age problems, number problems, percentage problems, and mixture problems.

Resources

Barker, Basic Algebra: Chapter 2.

Keedy, Introductory Algebra: Chapters 3 and 6.

Novak, Introductory Algebra: Chapters 3 and 4.

Transfer Math Fundamentals 5: Cartesian Graphing

This topic deals with the solution of problems by combination and/or interpretation of cartesian graphs to 1st and 2nd degree equations.

Tasks

TF5.1	Identify any point in the cartesian plane with an ordered pair of numbers.
TF5.2	Given an ordered pair of numbers (co-ordinates), plot any point in the cartesian plane.
TF5.3	Write the equation of a straight line in standard form.
TF5.4	Graph equations of straight lines.
TF5.5	Graph simple inequalities and absolute value sentences.
TF5.6	List the conditions for which lines are perpendicular.
TF5.7	List the conditions for which lines are parallel.
TF5.8	Given an equation or the graph of a line, find the slope.
TF5.9	Given any linear equation in 2 variables, construct its graph.
TF5.10	Given an equation in standard form, find the slope and intercept form.
TF5.11	Using the distance formula find the distance between any two points in the plane.

Resources

Barker, Basic Algebra: Chapter 8.

Keedy, Introductory Algebra: Chapter 6.

Keedy, Intermediate Algebra: Chapters 2 and 8.

Novak, Introductory Algebra: Chapters 6 and 7.

Transfer Math Fundamentals 6: Systems of Equations

This topic deals with the solution of problems requiring the application of pairs of equations.

Tasks

TF6.1	Construct the graphs of systems of linear equations.
TF6.2	Identify the graphic solution systems of linear equations.
TF6.3	Solve systems of equations algebraically by:

* substitution method,
* addition-subtraction method,
* multiplication-division method,
* combinations of the above.

Resources

Barker, Basic Algebra: Chapter 9.

Keedy, Algebra and Trigonometry: Chapter 2.

Keedy, Introductory Algebra: Chapter 6.

Keedy, Intermediate Algebra: Chapter 3.

Novak, Introductory Algebra: Chapter 7.

Transfer Math Fundamentals 7: Quadratic Sentences

This topic deals with the identification of quadratic equations and the solution of related problems by factoring.

Tasks

TF7.1 Define a quadratic equation.

TF7.2 Write quadratic equations in standard form, i.e., $ax^2 + bx + c$.

TF7.3 Identify the value of a, b, and c in any quadratic equation.

TF7.4 Explain and use the concept of zero products.

TF7.5 Solve quadratic equations by factoring.

TF7.6 Develop strategies for problem solving and apply strategies to selected problem situations.

Resources

Barker, Basic Algebra: Chapter 7.

Keedy, Algebra and Trigonometry: Chapter 4.

Keedy, Introductory Algebra: Chapter 10.

Novak, Introductory Algebra: Chapter 10.

TRANSFER MATH APPLICATIONS

Transfer Math Applications 1: Polynomials and Rational Expressions

This topic deals with the solution of problems through the application of polynomials and rational expressions.

Tasks

TA1.1 Define an algebraic fraction and recognize the restrictions placed on variables in the denominator.

TA1.2 Simplify algebraic fractions.

TA1.3 Add, subtract, multiply, and divide algebraic fractions.

TA1.4 Factor sum of cubes.

TA1.5 Factor difference of cubes.

TA1.6 Solve equations involving fractions.

Resources

Barker, Basic Algebra: Chapters 3 and 5.

Keedy, Algebra and Trigonometry: Chapter 13.

Keedy, Intermediate Algebra: Chapters 4 and 5.

Novak, Introductory Algebra: Chapters 5 and 8.

Transfer Math Applications 2: Radical Expressions

This topic deals with the application of radical expressions.

Tasks

TA2.1 Identify and explain the following terms of a radical expression: radical, radicand, root.

TA2.2 Multiply and simplify with radicals.

TA2.3 Divide and simplify with radicals.

TA2.4 Add and subtract with radicals.

TA2.5 Rationalize numerators and denominators.

TA2.6 Solve equations with radicals.

Resources

Barker, Basic Algebra: Chapter 6.

Keedy, Algebra and Trigonometry: Chapters 1 and 2.

Keedy, Introductory Algebra: Chapter 9.

Novak, Introductory Algebra: Chapter 9.

Transfer Math Applications 3: Quadratic Sentences

This topic deals with the solution of quadratic equations and related problems by the quadratic formula.

Tasks

TA3.1 Construct graphs of quadratic equations.

TA3.2 Solve quadratic equations by completing the square.

TA3.3 Solve quadratic equations by using the quadratic formula.

TA3.4 Translate problems into quadratic equations.

TA3.5 Find the discriminant of a quadratic equation and use it to determine the nature of the roots.

TA3.6 Find the maximum or minimum value of quadratic sentences.

TA3.7 Develop strategies to identify and solve problems including: rate - time - work problems and minimum-maximum problems.

Resources

Barker, *Basic Algebra*: Chapter 7.

Keedy, *Introductory Algebra*: Chapter 10.

Keedy, *Algebra and Trigonometry*: Chapter 4.

Novak, *Introductory Algebra*: Chapter 10.

Transfer Math Applications 4: Systems of Equations

This topic deals with the solution of problems involving (1) systems of equation in 2 variables, and (2) linear systems in up to 3 variables.

Tasks

TA4.1 Solve systems of linear equations, using 3 equations and 3 unknowns.

TA4.2 Solve linear and quadratic systems of equations.

TA4.3 Solve pairs of second degree equations.

TA4.4 Solve problems involving 3 linear equations and 3 unknowns.

TA4.5 Solve problems involving pairs of second degree equations.

TA4.6 Solve 3 x 3 systems of equations, using determinants and matrices.

TA4.7 Evaluate 3 x 3 matrices.

TA4.8 Use determinants and matrices in solving problems.

Resources

Barker, Basic Algebra: Chapter 9.

Keedy, Algebra and Triogonmetry: Chapter 2.

Keedy, Introductory Algebra: Chapter 6.

Keedy, Intermediate Algebra: Chapter 3.

Novak, Introductory Algebra: Chapter 7.

Transfer Math Applications 5: Trigonometry - Basics

This topic deals with the solution of problems requiring the use of trigonometric functions.

Tasks

TA5.1 Define the sine, cosine, and tangent ratios.

TA5.2 Use the sine, cosine, and tangent ratios to determine the missing side or the missing angle in a right triangle.

TA5.3 Solve problems requiring the use of sine, cosine, or tangent ratios in right triangles.

TA5.4 Find the values of sine, cosine, and tangent ratios for the quadrantal angles.

TA5.5 Find the values of sine, cosine, and tangent ratios for the special anges of 30°, 45°, 60°.

TA5.6 Apply the Pythagorean Theorem to the trigonometric solution of problems.

Resources

Keedy, Algebra and Trigonometry, Chapter 8.

NOTE: For more advanced work, see TA11: Trigonometry - Advanced.

Transfer Math Applications 6: Imaginary and Complex Numbers

This topic deals with the extension of the number system to include imaginary and complex numbers.

Tasks

TA6.1 Define a complex number.

TA6.2 Add, subtract, and multiply complex numbers of the form $a + bi$ where $i = \sqrt{-1}$ and therefore $1^2 = -1$.

TA6.3 Find the conjugates of complex numbers and use them in the division of complex numbers.

TA6.4 Determine if the roots of $ax^2 + bx + c = 0$ (a, b, c, e, r) are complex by using the discriminant. Determine the graph of complex roots.

TA6.5 Find the sum and difference of complex numbers graphically.

Resources

Keedy, Algebra and Trigonometry. Chapter 12.

Transfer Math Applications 7: Conics

This topic deals with the solution of problems involving circles, ellipses, parabolas, and hyperbolas.

Tasks

TA7.1 Define: focus, parabola, ellipse, and hyperbola.

TA7.2 Identify the equations of circles, ellipses, hyperbolas, and parabolas.

TA7.3 Given an equation of a circle, express the equation in standard form and construct the corresponding graph.

TA7.4 Given the equation of an ellipse, put the equation in standard form and construct the corresponding graph.

TA7.5 Given the equation of an hyperbola, put the equation in standard form and construct the corresponding graph.

TA7.6 Given the equation of a parabola, put the equation in standard form and construct the corresponding graph.

Resources

Keedy, Algebra and Trigonometry: Chapter 14.

Transfer Math Applications 8: Exponential and Logarithmic Functions

This topic deals with the solution of problems by application of exponential and/or logarithmic functions.

Tasks

TA8.1 Define exponential and logarithmic functions.

TA8.2 Find logarithms and antilogarithms of numbers, using a calculator.

TA8.3 Given an exponential equation, find an equivalent logarithmic equation and vice versa.

TA8.4 Apply the properties of logarithms in solving logarithmic equations.

TA8.5 Apply logarithms to solving problems such as:

* radioactive decay problems,
* continuous growth problems,
* compound amount problems,
* population growth problems.

TA8.6 Apply logarithms to evaluating exponential expressions and computations, using a calculator.

Resources

Keedy, Algebra and Trigonometry: Chapter 7.

Transfer Math Applications 9: Polynomial Functions and Graphing Techniques

This topic deals with polynomial functions, including rational roots, synthetic division, and graphing techniques.

Tasks

TA9.1 Define the following terms and notations: relation, function, mapping, image, domain, range, f(x).

TA9.2 Given a relation or function, determine whether its inverse exists, write or graph the inverse, and solve related problems.

TA9.3 Use synthetic division to find factors of polynomials.

TA9.4 Solve polynomial equations.

TA9.5 Identify the inverse of graphs.

TA9.6 Slide a graph horizontally and vertically.

TA9.7 Determine how changing coefficients in equations affect the graph either vertically or horizontally.

Resources

Keedy, Algebra and Trigonometry: Chapters 3 and 13.

Transfer Math Applications 10: Sequences, Series, and Binomial Theorem

This topic deals with solution of problems requiring the knowledge of arithmetic and geometric series and binomial theorems.

Tasks

TA10.1 Calculate the arithmetic mean of any number of terms of an arithmetic progression.

TA10.2 Determine the formula for the sum of an arithmetic series, and write the sum for a given number of terms in an arithmetic series.

TA10.3 Determine the formula for the sum of a geometric series, and write the sum for a given number of terms in a geometric series.

TA10.4 Determine the formula for the sum of an infinite geometric series, and find the sum of infinite geometric series.

TA10.5 Expand binomials such as $(a+b)^n$ when n is an integer less than 10.

TA10.6 Find any term of a binomial expansion.

TA10.7 Develop a strategy to identify problem types and solutions, and solve problems requiring the use of arithmetic and geometric progression or the binomial theorem.

Resources

Keedy, Algebra and Trigonometry: Chapters 15 and 16.

Transfer Math Applications 11: Trigonometry - Advanced

This topic deals with the solution of problems by trigonometry, including application of sine and cosine laws, double and half-angle formula, with emphasis on a functions approach.

Tasks

TA11.1 Determine the trigonometric formulae for the sum and differences of two angles and solve related problems.

TA11.2 Determine the trigonometric formulae for double angles and half-angles.

TA11.3 Solve open sentences requiring substitution of any of the trigonometric identities.

TA11.4 Convert degree measure to radians or vice versa, and solve related problems.

TA11.5 Graph the functions y = sin x, y = cos x, and y = tan x.

TA11.6 Solve conditional trigonometic equations.

TA11.7 Solve problems involving trigonometry, including use of sine and cosine laws, double and half-angle formula, with emphasis on a functions approach.

Resources

Keedy, Algebra and Trigonometry: Chapters 8, 9, 10, and 11.

NOTE: For more basic work, see TA5: Trigonometry-Basics.

ABE

PRINCIPLES OF ADULT LEARNING

Adult education instructors tend to agree on a number of generalized observations about how and why adults learn. It may be reassuring to discover that these observations are well supported by a steady stream of research studies and syntheses of knowledge about adult learning. The following list is extracted from Knox (1978); similar principles are listed by Kidd (1973), Dickinson (1973), and Brundage and MacKeracher (1980).

1. **Performance**: Adult learning usually entails change and integration of knowledge, skills, and attitudes to produce improved performance. Adults typically engage in a continuing education activity because they want to use what they learn soon after they learn it.

2. **Motivation**: The educational goals, sources of encouragement, and barriers that characterize an adult's life situation shape the reasons for participation. Motives are multiple and varied in their specificity and in the extent to which the learner is aware of them. Overly intense motivation becomes anxiety, which interferes with learning.

3. **Meaning**: Adult learning is more effective when it entails an active search for meaning and discovery of relationships between current competence and new learnings.

4. **Experience**: An adult's prior experience influences the approach to a learning episode and its effectiveness. Prior learning may either facilitate, interfere with, or be unrelated to new learnings.

5. **Learning Ability**: Learning ability is relatively stable between 20 and 50 years of age, with gradual decline thereafter; abilities that are associated with adult experience, such as vocabulary, are best maintained and enhanced; and adults who were initially the most able of their age group tend to increase their ability so that the range in abilities increases with age. Adults with the greatest learning ability tend to learn more rapidly and to learn complex tasks more readily.

6. **Memory**: An adult's ability to remember information depends on the strength of the registration and on the factors operating to erase the registration. The strength of registration depends on intensity, frequency, and importance to the learner. The factors that erase the registration include the passage of time and the activity that follows the exposure. Recall is best under conditions that are similar to the original registration.

7. **Condition**: An adult's ability to learn can be substantially reduced by poor physical and mental health. Condition and health include both gradual decline into old age and temporary problems. The decline for older adults in their vision and hearing can affect learning. Much can be corrected by glasses, better illumination, hearing aids, and sound amplification.

8. **Pacing**: Adults typically learn most effectively when they set their own pace. Adults vary greatly in the speed at which they learn best. Older learners tend to reduce the speed of learning and to give greater attention to accuracy.

9. **Complexity**: An adult typically learns best when the learning task is complex enough not to be boring, but not so complex that it is overwhelming.

10. **Content**: The process of effective learning by adults varies with the content or nature of the learning task.

11. **Feedback**: Adults learn more effectively when they receive feedback regarding how well they are progressing. This applies to learners of any age. Immediate feedback, recognition, and reward help to shape and reinforce new learning.

12. **Adjustment**: Adults typically learn less well when they experience substantial social or personal maladjustment. When adults believe they can deal with a situation, it may represent a challenge; when they do not, it may be perceived as a threat.

MATH ANXIETY

Research indicates that anxiety about mathematics may represent a major barrier to learning for many adults. Studies also indicate that there is no single factor that can be identified as the cause of math anxiety, (Gaskill, 1978). It seems, rather, that a complex and interwoven set of influences work together to generate the anxiety that many instructors have recognized in their students.

The previous experiences of adults, even as far back as elementary school, their perceptions of the real value of mathematics, and the fear of being wrong, or of making a mistake, are commonly contributing factors. It has also been suggested that the various sexual biases of society have been particular causes of math anxiety in women.

Regardless of the cause of math anxiety, instructors have been developing a number of strategies to help learners overcome or at least deal effectively with the problem. In general, a positive, supportive approach providing many early opportunities for success is advised. "Success breeds success". Gradually, the cumulative experiences of facing a situation or problem, coping with it, and experiencing successful resolution of the task will build feelings of success that will supplant the anxiety.

Here are some other recommended strategies.

* Begin the anxious learner at a level of instruction well below the frustration level. Many instructors explain the process to the "anxious" learner by emphasizing the benefits of a warm-up. This simple procedure will allow the learner to build on a basis of early success.

Make every effort to relate mathematical concepts to the learner's own experience. Because the anxious adult learner has most probably avoided situations involving computation or terminology, be very certain that the terminology commonly employed is part of the learner's working vocabulary.

* Attempt to instil the idea that mistakes are not only acceptable but - when identified as such - can be most valuable learning experiences.

* Urge learners to ask questions - even questions they believe to be trivial. "There is no such thing as a stupid question!" At the same time keep firmly in mind that an off-hand remark about a problem being "easy" may be internalized by a learner in a manner very different from that which is intended. "If its easy and I'm confused then I must be stupid."

* Provide learners with opportunities at the concrete level. (The concept of a fraction is not as "easy" to internalize as one assumes.)

* Emphasize the transferability of "real-life" problem solving to the solution of math-based problems.

A word of caution is appropriate here. Some anxiety symptoms may be brought on by the natural apprehension associated with a new situation (such as math or computer work); but there are other displays of anxiety that may well be related to deeper personal and social problems. It may be desirable in either case for the instructor to consult with or refer to a counsellor trained to assist people in handling such problems.

PROBLEM SOLVING IN MATHEMATICS

(Adapted from Mathematics 221, 231, 241:'A Teaching Guide', published by the Nova Scotia Department of Education.)

It is particularly important for adult learners to be conscious of the general nature of problem-solving techniques and to see that applications have some immediacy to their life situation. Solving problems and making decisions in mathematics require the same processes as solving problems in many other situations.

While one can argue the validity of many problem-solving algorithms, the following chart incorporates those features commonly held to be useful.

A GENERAL ALGORITHM	A MATHEMATICS ALGORITHM
1. Interpret and analyse the situation.	1. Understand and define the problem.
2. Collect information.	2. Collect information - check for latent information.
3. Decide the most effective and appropriate plan of attack.	3. Translate the problem to a mathematical expression.
4. Determine the operational aspects of putting the plan into effect.	4. Manipulate the mathematical expression.
5. Verify that the solution is satisfactory.	5. Check the answer for reasonableness.
6. Communicate the solution of the problem, either by actually using the result or by explaining it to someone else.	6. State the answer to the problem in sufficient detail that it is understandable to someone else.

The application of these concepts and skills to mathematics does not come easily to adult learners - even though they may intuitively apply the same procedures in their everyday lives. Many learners - some might argue a majority - concentrate all their energies on the manipulation step, that of performing the actual mathematical operation (often a simple computation requiring recall of previously learned math procedures). Because instructional materials tend to present patterned "word problems" based on a "just taught" skill, this approach is often rewarding. It often leads to the 'right' answer (the one in the answer key). The learner, however, may never achieve the satisfaction of internalizing an effective problem-solving strategy.

'Real' problem-solving activities and situations should be an integral part of every unit of study, whether the topic be finance, geometry, measurement, statistics, the number system, or any other. The real aim of every math course is to enable people to solve problems. Especially in the adult basic education context, the more relevant the problems are to present or future goals, the greater will be the impact on learning.

An ideal mathematics course for adult learners will enable them to develop and apply such 'higher leel thinking skills' as:

- interpretation,
- generalization,
- pattern recognition,
- estimation,
- evalution of alternative solutions.

General Recommendations

1. Problem solving should be highlighted as an important component of every mathematics course and be given prominence in course descriptions and outlines. This stated emphasis will remind both learners and instructors of the central place of problem solving in the curriculum.

2. Problem-solving strategies learned in mathematics may be applied in other subject areas and used in solving a variety of real-life problems of interest to adults.

3. Learners can develop their own problem-solving algorithms. Computer flow-charting may also be introduced, as an aid to development of analytic skills and the sequencing of steps towards a solution.

4. To illustrate the necessity for clear and complete enunciation of a problem, learners may be shown how to write computer programs.

Teaching Problem Solving

While problem solving may also be treated as a holistic process, there appear to be several logical techniques for developing and strengthening specific aspects of that process. As an example, here are a few techniques.

- Illustrate different ways that problems may be described and translated.

* Have learners translate problems into different modes of communication, e.g., pictorial, symbolic, verbal, concrete.

* Have learners indicate the process that is required to solve a problem without actually carrying it out.

* Put the emphasis on the process, by substituting simple numbers in an apparently difficult problem.

* Provide problem situations with incomplete data, requiring learners to identify what additional data are needed in order to work the process.

* Show learners how to translate real-life problem situations into mathematical equivalents.

* Require students to estimate solutions, especially before verifying them on a calculator.

THE COMPUTER -- A TEACHING TOOL

(Based on Walter Muir, Computer Awareness: An Introduction for Teachers. Victoria, B.C. Ministry of Education, 1983. It is used with permission.)

The purpose of this section is to remind instructors of the potential of the computer as a tool for instruction in mathematics. It includes a definition of computer literacy, and guidelines for evaluation and selection of courseware. Readers will recognize the similarity between a computer problem-solving sequence and that advocated in the previous section for general mathematics learning.

Computer Literacy

Just as the Indsutrial Revolution created the need for a 'literate' populace that could understand and work effectively with machines, the Computer Revolution has created the need for people who are skilled in the use of computers. The term 'computer literacy' therefore refers to a general understanding of computers, and an ability to use them in practical ways.

Specifically, the 'computer literate' educator will have acquired:

- Knowledge of the history of computing;
- An understanding of the components of a computing system;
- An awareness of how computers function and how they are programmed;

- An understanding of the range of possible educational applications and the ability to implement the most appropriate ones;
- An awareness of the sources of hardware and software;
- The ability to evaluate the effectiveness of programs and applications;
- Knowledge of career opportunities in computers; and
- An awareness of the present and possible future effects of computer technology on society.

The Computer as an Aid to Learning

Computer Assisted Instruction (CAI) has been used very successfully by universities, by business and industry, and by the military, since the 1960s. PLATO systems, for example, developed at the University of Illinois, and in use throughout North America, have provided effective instruction in medicine, engineering, physics, chemistry, creative writing, and many other disciplines. CAI is one of several terms used to describe the interaction of a learner with a computer. Other terms include Computer Aided Learning (CAL). For the purposes of this section, the term CAI will be used to include all of these applications.

Considerable research into CAI has been carried out over the past 20 years, most of which has shown that well-designed CAI is at least as effective as the traditional methods of lecturing and note-taking. A further benefit, particularly to slower learners, is that CAI allows each learner to proceed at an individual rate while the computer acts as a patient tutor. The main CAI modes currently in use are 'Drill and Practice' and 'Tutorials'.

Drill and Practice is the lowest level of CAI, and it is probably the one most frequently used in education at this time. These routines are used mainly in the development of basic skills in such areas as vocabulary, spelling, arithmetic operations, geometric and algebraic relationships, or balancing chemical equations. In other words, the major benefits occur in circumstances where repetition can improve the learning of operations and concepts.

Tutorials: When a learner is presented with new information by a computer and is regularly tested to determine whether the information has been learned, then CAI is functioning in the Tutorial mode. The best tutorials are capable of taking a learner from virtually no knowledge of a topic to a very high level of understanding. In planning CAI sequences, the question that should always be asked is, "Can CAI improve upon the learning that would otherwise occur?" If the answer is no, it is probably better to use a traditional approach. However, it the answer seems to be yes, try CAI and evaluate the results.

Computer-Managed Instruction

Many instructors have applied the principles of Individually Prescribed Instruction (IPI) to computer-managed instruction. This approach involves breaking the content to be learned into relatively small packages or 'learning modules'. Each module is comprised of a variety of learning activities such as reading a resource book, doing library research, or viewing a videotape. Students proceed independently through successive modules and are tested at the completion of each to determine whether the minimum criterion for mastery has been achieved.

A major problem with a conventional modular course has been the amount of 'paperwork' required to record the progress of each student. Computers offer an efficient solution since they can be programmed to perform such tasks as prescribing learning activities on a daily or weekly basis, and presenting and scoring the criterion tests. They can also record the results of the test and direct the student to the next phase of learning.

Simulations

For more than 20 years, computers have been used to simulate a great variety of phenomena, including the growth of the world's population, the economies, of nations, the ecology of vast land areas, chemical reactions at very high temperatures and pressures, the flight of jet aircraft, even the functioning of the human brain.

Simulations have also been programmed for classroom use. They include graphing of complex functions, charting stellar constellations, physics and chemistry experiments, genetics laboratories, the operation of automotive engines, the operation of small businesses, and many others. Well-designed computer simulations of this nature can help instructors provide students with unique learning experiences.

Problem Solving

The computer has the capacity to supplement the mental functions of humans in many useful ways. It greatly enhances one's ability to perform calculations, and to store and retrieve information.

Problem solving has been an important part of mathematics and science curricula for many years. Applications of mathematical concepts to the real world can be found in almost every current mathematics publication. Furthermore, there is virtually no limit to the variety of such problems to which the computer can be applied.

The following steps constitute a general procedure that may be used to solve a problem with the aid of a computer.

1. Analyse the Problem: This step involves breaking the problem down into its component parts. The student will then determine the additional information and resources needed to proceed.

2. Develop an Algorithm: Creating the procedure by which the problem will be solved is the most important step. It is here that the student's knowledge of the subject matter will be directly applied. Each detail of the procedure should be clearly stated. A relatively simple problem, such as calculating the area of a rectangle, could be dealt with as a single procedure. A more complex problem could require several 'sub-algorithms' to be developed separately and finally merged to provide a single comprehensive solution.

3. Prepare a Flowchart: The advantages of a flowchart is that it provided a 'picture' of the procedure to be applied. It permits the learner to check for accuracy at an intermediate point.

4. *Write the Program:* The flowchart then must be translated into the language of the computer. This requires a basic understanding of a computer language by both instructor and student.

5. Debug the Program: Removing the errors from a computer program provides the learner with another opportunity for analytical thinking. Unlike humans, who can often 'fill in the blanks' when incomplete information is given, the computer is unable to make assumptions about what the programmer intended. Every little detail of the program must be correct.

6. Document the Program: Once the student and instructor are satisfied that the program has correctly solved the problem, the student should formally 'document' (describe) the program. Good documentation is critical to the future use of a computer program.

These six steps may be applied to solving virtually any problem in any subject area. The challenge to instructors is to identify appropriate problems and to assist their students in solving them.

The Electronic Blackboard

The computer's ability to store, retrieve, and display information can be used in many instrumental situations. With appropriate cable connections, a computer's output can be fed into one or more television monitors at once to provide the instructor with an 'electronic blackboard'. Print and graphic presentations may be prepared in advance, stored on a diskette, and then presented as many times as necessary. Moreover, the materials can be quickly modified or updated.

Programming for the electronic blackboard is relatively easy; it is simply a matter of entering the textual material into a series of PRINT statements. The presentation routine permits the instructor to advance to the next step in a sequence by simply touching a key on the computer's keyboard. If a printer is attached to the computer, 'hard copy' notes, identical to those appearing on the screen, may be printed for the class. To further simplify the process, programs are available that provide 'shells' into which the instructor can enter the information to be presented. Some programs will generate large characters that can be more easily seen by the viewers. Graphic illustrations can also be presented on the screen as part of an instructional sequence. Again, the content of virtually any subject may be presented in this way.

Achievement Testing

With a computer it is possible for instructors to administer their own tests and receive the results on the same day the test was administered. This can be done either by having each student sit at the computer and answer the questions 'on-line', or by having learners respond to the test on computer cards, which can be quickly entered into the computer through a card reader for scoring and analysis.

Computers are being used to store 'item banks' (i.e., files of test questions in various subject areas). The banks may be purchased on diskettes that include the test items and the programs necessary for selecting items and printing a test, and for modifying the items. Useful items may be retained for future tests, while faulty items can be modified or discarded and new ones added. The main advantage to the instructor is the speed with which tests can be created. All the instructor needs to do is specify the items to be included in the test and the computer will print two versions of the test; one that can be used as the 'master' for copying, and one that constitutes the 'answer key'. Item banks can remove much of the effort required to create classroom achievement tests and can help to improve their quality.

Acquiring Software and Courseware

There are several ways to acquire software and courseware for review. The most convenient may be to consult with a fellow instructor who is already using programs of the type you have in mind. Alternatively, there are a growing number of central sources.

In British Columbia, the Provincial Educational Media Centre (PEMC) has the responsibility to acquire and distribute software, at cost, to the schools of the province. A list of software currently available can be obtained from PEMC, at 7351 Elmbridge Way, Richmond, B.C. V6X 1B8.

Software and courseware information is also available from the Computer Using Educators of B.C. (CUEBC), a specialist association of the B.C. Teachers' Federation, also based in Vancouver.

Computer stores are other important sources of software. In addition to the packages they have on hand, most computer stores have catalogues that describe the software and courseware available for the computers they sell.

Evaluating Courseware

The quality of available courseware varies greatly. Courseware should be evaluated by those who actually use it, and it is then helpful if the results of these evaluations can be made available to others.

A number of educaticnal authorities have established courseware evaluation services to assist instructors. In British Columbia, the Provincial Educational Media Centre provides a courseware evaluation service in parallel with its responsibility to acquire and distribute high-quality courseware; and PEMC involves instructors throughout the province in field-testing and evaluating computer-based materials. Courseware is evaluated according to a standard form and an 'evaluators guide'.

The results of these courseware evalutations are published regularly by PEMC in Evaluations: Mircowave, which is distributed to computer-using instructors and school district resource centres. You may obain copies of the evaluation form and guide, or be put on the mailing list for Evaluations, by contacting PEMC directly.

EVALUATION OF STUDENT PROGRESS

In ABE mathematics courses, several key decisions must be made concerning the method and procedures of evaluating student progress.

Many instructors prefer (and some institutions require) formal evaluation by tests. However, it is possible to evaluate student progress on the basis of day-to-day class work, written assignments, participation in discussion, etc. These are more natural methods than formal testing and may be less stressful for students. On the other hand, the instructor's marking load is likely to be greater.

Some ABE programs use formal tests at the end of each unit and also require a final examination at the end of the course. If a broad choice of possible units is available, then preparation of a final examination will require careful advance planning.

An important emphasis in the mathematics curriculum is to equip students with the knowledge needed to use or understand mathematics in daily life as well as in training for careers. Any testing should therefore emphasize the practical application of mathematics wherever this is appropriate.

Guidelines for Test Construction

A student is asked to write a test or do an exercise. The instructor does not want an evaluation to take too much time to prepare or mark. The following guidelines are suggested to facilitate the task for both student and instructor.

First, the purpose of evaluation should be clear, so that tests can be constructed to suit that purpose. Typically, three types of tests are commonly used, each with a distinct purpose.

- Placement tests find out if a course is appropriate for a student. Do students know the course content and manipulative skills already? If not, do they know enough to begin?

- Formative tests measure how well students are achieving learning objectives, for the purpose of improving instruction. When objectives are not met, the material may need to be retaught or additional work assigned. These tests are not used in the determination of letter grades for students.

- Summative tests determine if learning objectives have been attained to such an extent that a student has 'completed' a unit or course of instruction. These tests may be used to determine letter grades, and/or competence to proceed to a new learning objective.

Other uses of tests may include providing motivation, increasing retention and transfer of ideas, or increasing understanding. In these senses, they are more akin to instructional techniques than assessment devices.

General Principles of Test Construction (Gronlund, 1977)

1. Tests should measure clearly defined learning outcomes that are in harmony with the instructional objectives.

2. Tests should measure a representative sample of the learning outcomes and subject matter included in the instruction.

3. Tests should include the type of test items that are most appropriate for measuring the desired learning outcomes.

4. Tests should be designed to fit the particular uses to be made of the results.

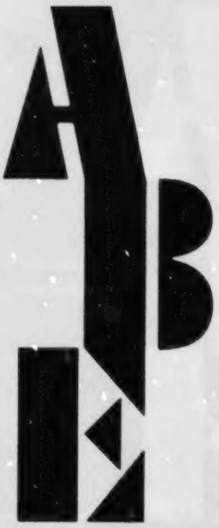
5. Tests should be as reliable as possible and should then be interpreted with caution.

6. Tests should be used to improve student learning.

Critical tasks in test construction include the selection of test items, ensuring correct interpretation of the question, and the assignment of marks.

Test scores may be norm-referenced - i.e., may indicate how an individual's performance compares to that of others - or may be criterion-referenced - i.e., indicating how performance compares to a pre-set standard. Criterion-referenced testing may also be called mastery testing. Letter grade systems may be developed for either approach. Whichever is used, a score interpretation guide should be prepared.

It should be noted, however, that evaluation is not the same as grading. Evaluation is, at best, a continuous process, which enables both learner and instructor to control learning, somewhat along the lines of a system's thermostat. Evaluation is thus most effective if it directs corrective action before learning difficulties get out of control.



INSTRUCTIONAL RESOURCES

This selection of learning materials is divided into two parts: keyed texts listed in the array of learning topics and tasks (Part 3 of the guide), and supplementary texts of general use. It should be noted that many other texts could be appropriate for this curriculum. Accompanying tests, supplementary materials, and instructor manuals are also usually available.

Keyed Texts

Barker, Jack, and others. *Arithmetic*. 3rd edition. New York: Saunders, 1983.

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Schell, Frank R., and Bill J. Matlock. Practical Problems in Mathematics for Welders, Albany, N.Y.: Delmar, 1982.

Woodside, Betty. Brush Up Your Math - A How-to Handbook. Toronto: McGraw-Hill Ryerson, 1982.

PROFESSIONAL REFERENCES

The following selected list includes publications (other than instructional resources) specifically referred to in this guide, as well as a number of other sources of pedagogical background and ideas for improving instruction.

Part 1: Curriculum Guides and Related Documents

British Columbia. Ministry of Education, Continuing Education Division.

Adult Basic Literacy Assessment Kit, 1981. ($10.00)
Adult Basic Literacy Curriculum and Resource Guide, 1980. ($5.00)
ABE English and Communications Curriculum Guide, 1982. ($5.00)
ABE Science Curriculum Guide, in press.
"Curriculum Development in Adult Basic Education". (unpublished, 1983).
ESL for Adults: English for Work, 1982. ($10.00)

British Columbia. Ministry of Education, Curriculum Development Branch.

Mathematics: Years One to Twelve Curriculum Guide, 1978. ($2.00)

(Above titles available from Publication Services Branch, 878 Viewfield Road, Victoria, B.C. V9A 4V1, at stated prices plus 10% handling).

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